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The first British sports car specifically designed to take full advantage of the inherent properties of polyester resin/glass fibre construction, is the high speed, low cost Berkeley—now being manufactured by Berkeley Coachwork (Sales and Export) Limited.

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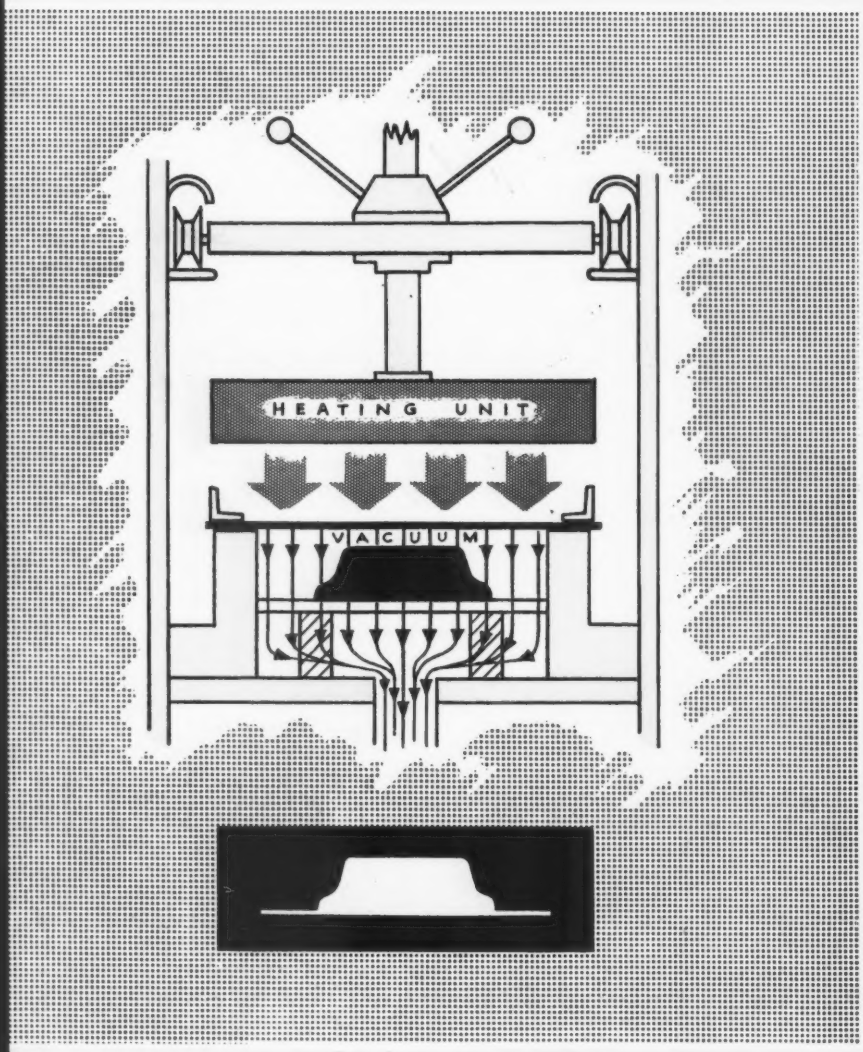

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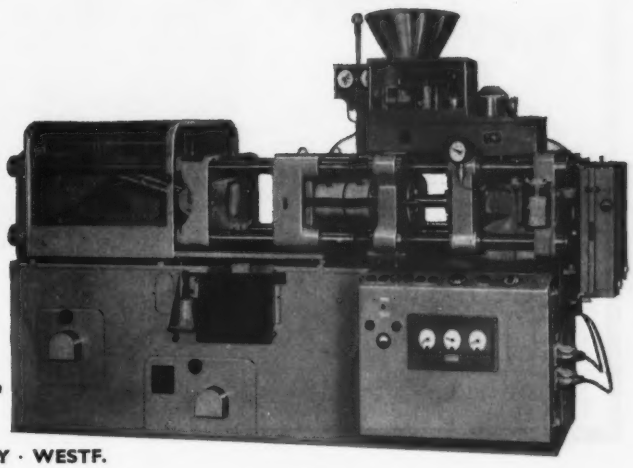

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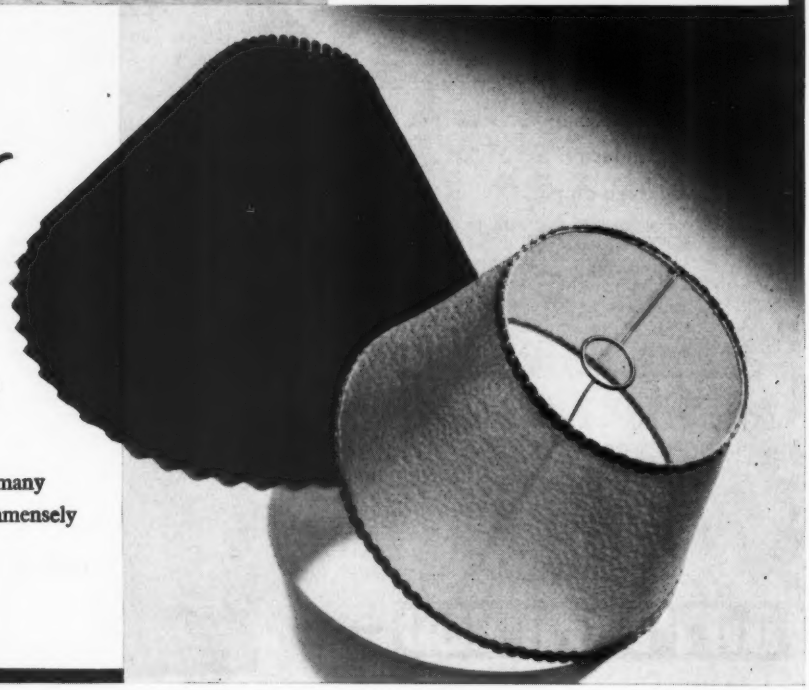

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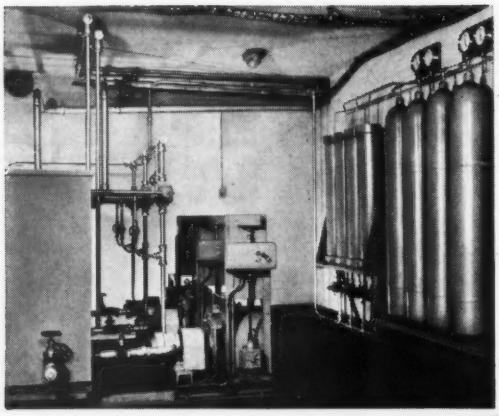

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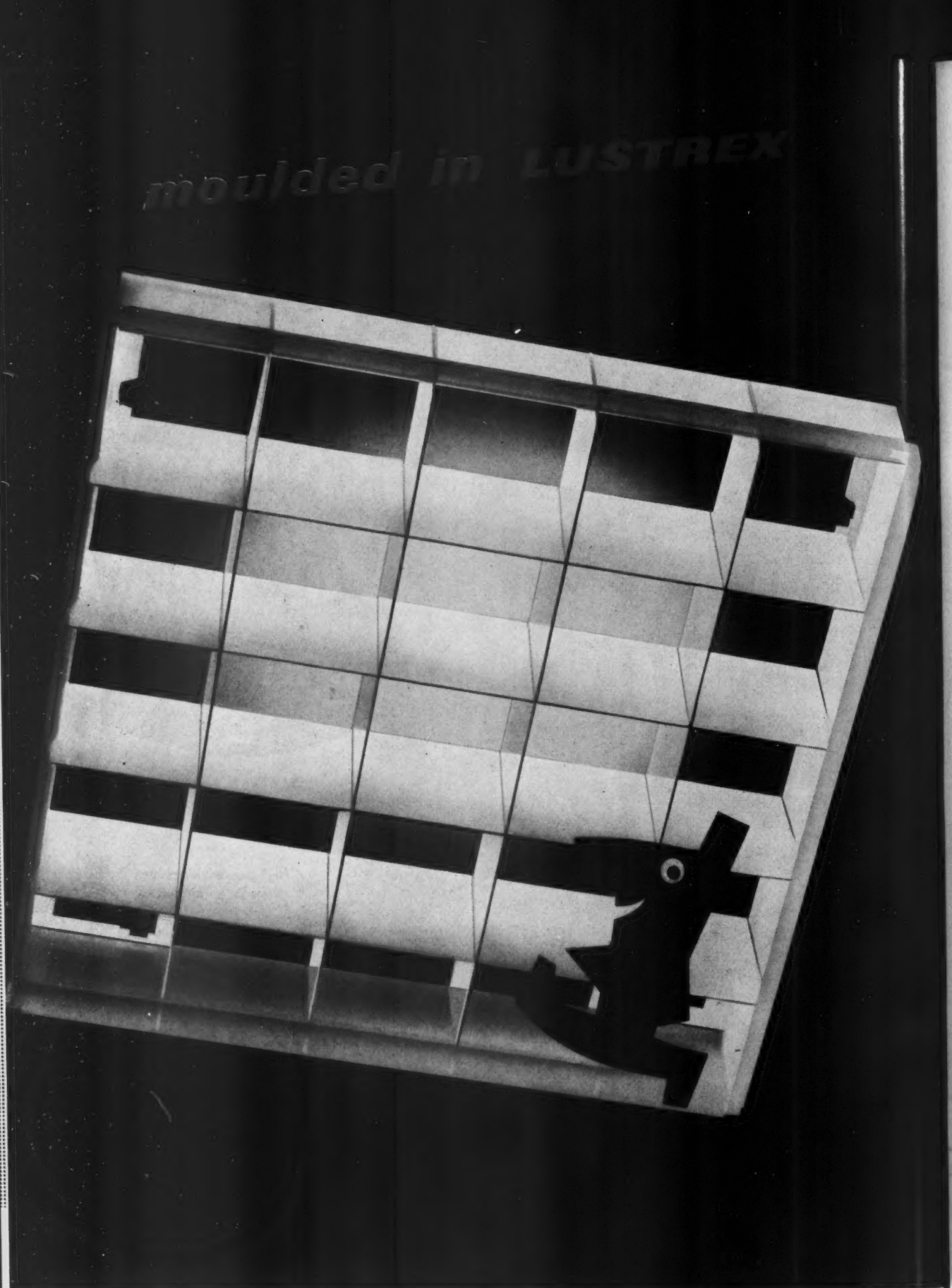

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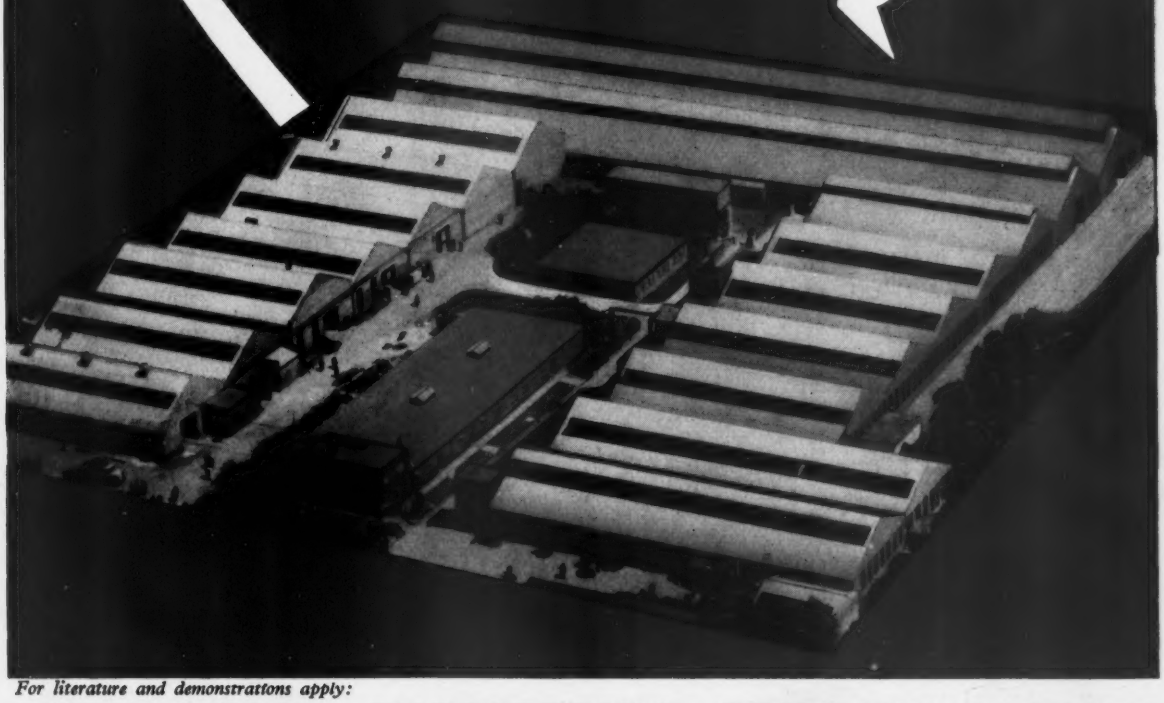

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PLASTICS INJECTION MACHINES

SPECIFICATIONS

	Model 100-H-12	Model 400-H-28	Model 600-H-40
Volume moulded per shot (cu. ins.)	20	24	40
Weight moulded per shot (ozs.)	12	28	48
A prepacking or plastic stroke's feed (ozs.)	14	28	54
Plasticising capacity (lbs./hour)	115	275	350
Rate of injection (ozs./second)	16	19½	49
Size of die plates	28" x 17"	36" x 27"	38" x 27"
Space between tie bars	17" x 28"	27" x 27"	29" x 29"
Mould opening stroke	20"	22"	22"
Maximum die space	28"	49"	51"
Maximum die opening speed	25"	24"	27"
Minimum die space	10"	12"	12"
Minimum die opening speed	4"	5"	5"
Mould locking pressure (US tons)	200	400	400
Mould locking pressure (long tons)	178	357	357
Capacity of [illegible]	100	150	150
Power consumption of heating zone when plastic [illegible] capacity (k.w.)	11.5	20.5	27.5
Motor rating	40 h.p. universal	60 h.p. universal	100 h.p. universal
Shipping weight (approx. tons)	9.5	17	23.5
Overall [illegible]	19' 6" x 6' 3"	30' 6" x 8' 0"	32' 6" x 8' 0"

Injection capacities specified above are for general purpose polystyrene.

Details of other H.P.M. plastics injection machines on application.

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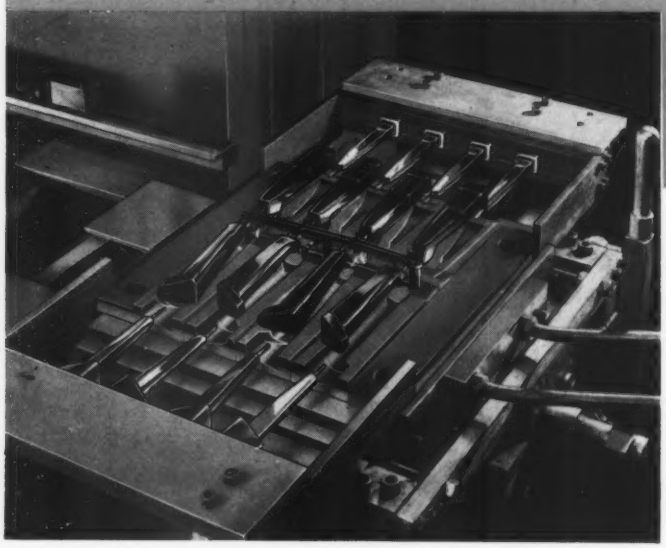
THE PRODUCT

The two handles for the latest pressure cooker consist of an upper and a lower moulding, carefully designed to meet together. Both mouldings are hollowed out, entailing long and slender core pins which dictate the use of a transfer type mould.



THE TOOL AND PRESS

The tool is designed to produce four upper and four lower handles at a time on a BIPEL Type 200 Auto Control Press. The die plate is withdrawn into an auxiliary fixture, where all the side cores are withdrawn at the same time and where, with pneumatic assistance, all the eight mouldings are ejected from their dies.

THE MATERIAL AND PELLETS

The handles are moulded from Phenolic material, the total weight needed for eight mouldings being 22 ounces. This large charge is loaded as six pellets, made in a BIPEL Pelleter, and preheated to speed up production.

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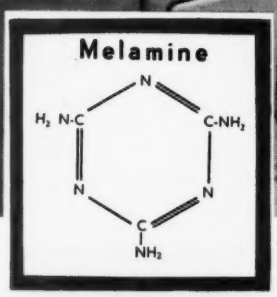

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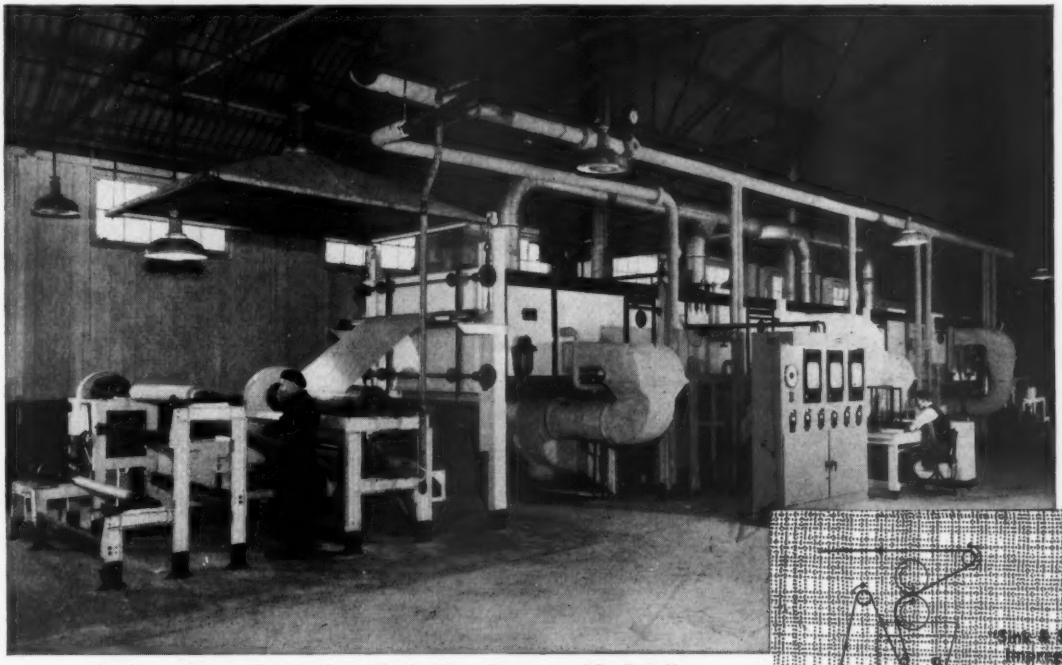
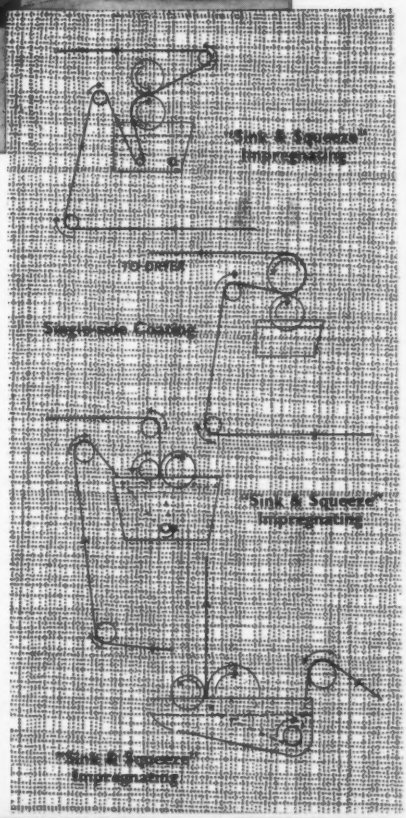


Continuous Horizontal Impregnating and Stoving Plant. (By courtesy of Catalin Ltd.)



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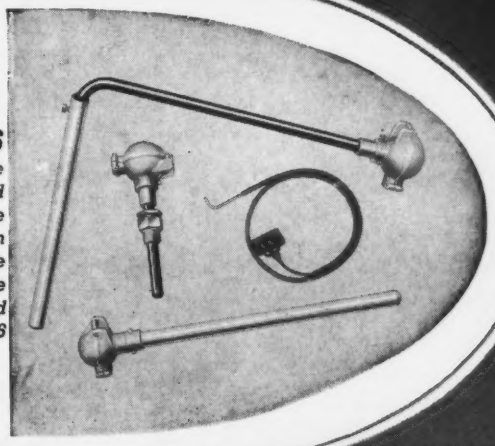

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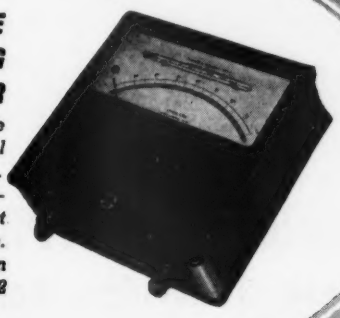

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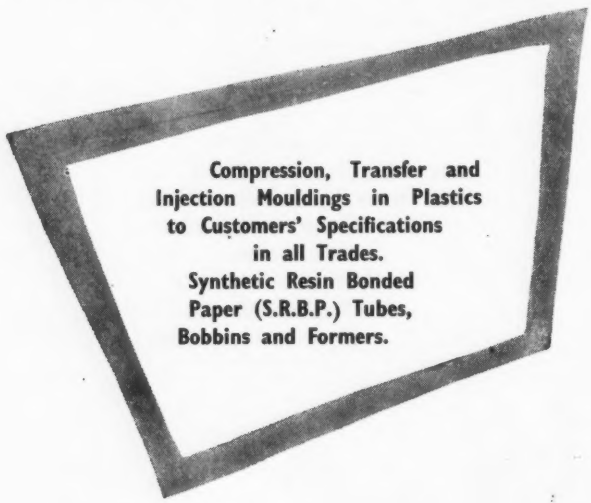

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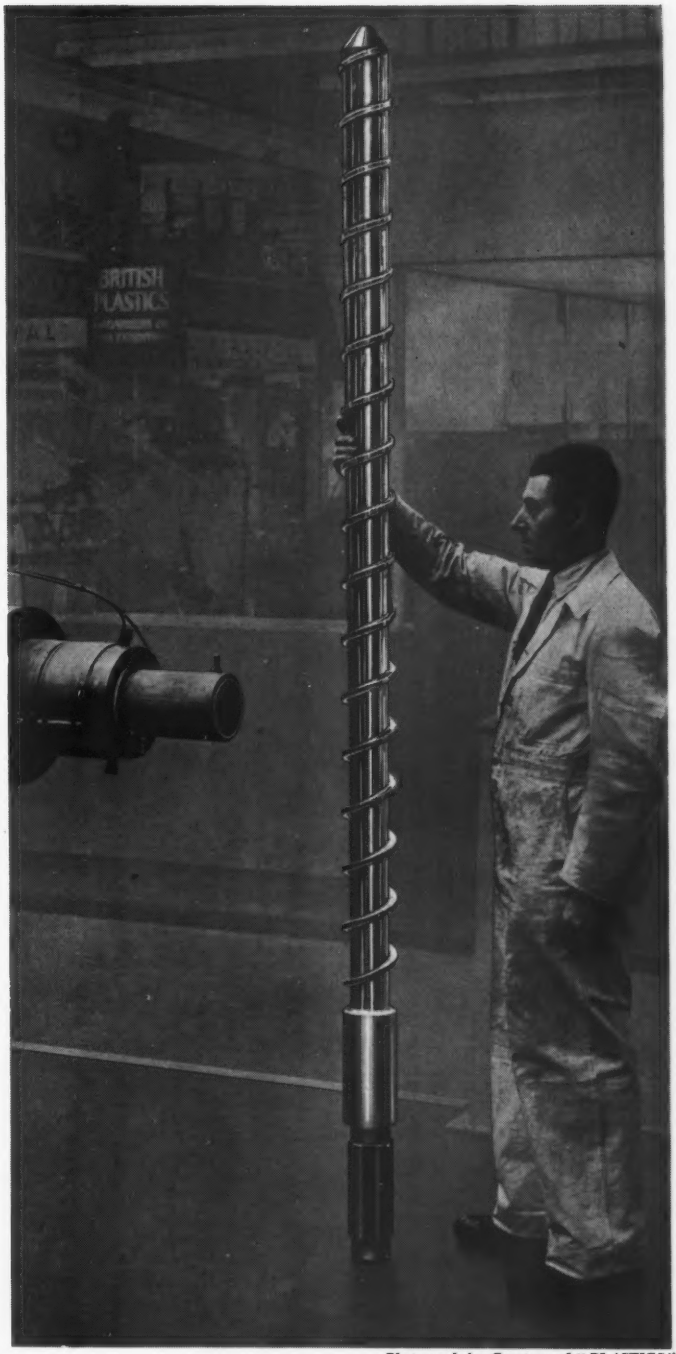

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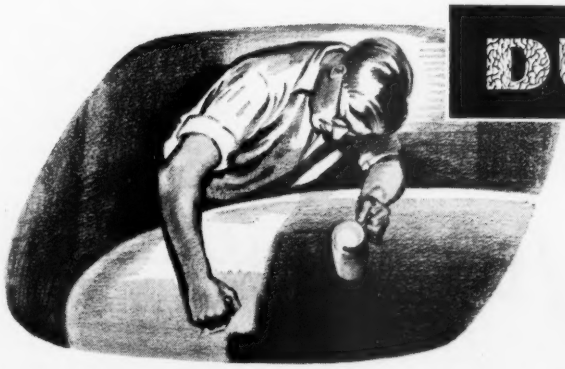

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Pioneer Polyesters

Scott Bader have been manufacturing polyester resins for 10 years, and during this time an unrivalled reputation has been achieved for consistency, prompt delivery and sound technical service.

Crystic 189	for boat construction. The finest polyester available.
Crystic 191	the most widely used polyester for general moulding work, commercial vehicles, caravans, etc.
Crystic 195	for roof sheeting having maximum clarity.
Crystic 300	the first, and still the best, self extinguishing resin.
Marco Resin SB. 28D	the very latest heat resistant polyester, with no processing limitations.

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No dog, no vanman, no load—yet. When they come, this B.R.S. van, built by Holmes Ltd. of Preston, will have a hard life. And from road to roof it is ready to take it. The translucent roof especially: it is tough enough to take a poke from a pole or a bang from a box. It is made of Fibreglass Reinforced Plastic, the material that doesn't drum, dent or corrode, that can be moulded to complex shapes in one piece—without high pressures or costly equipment.

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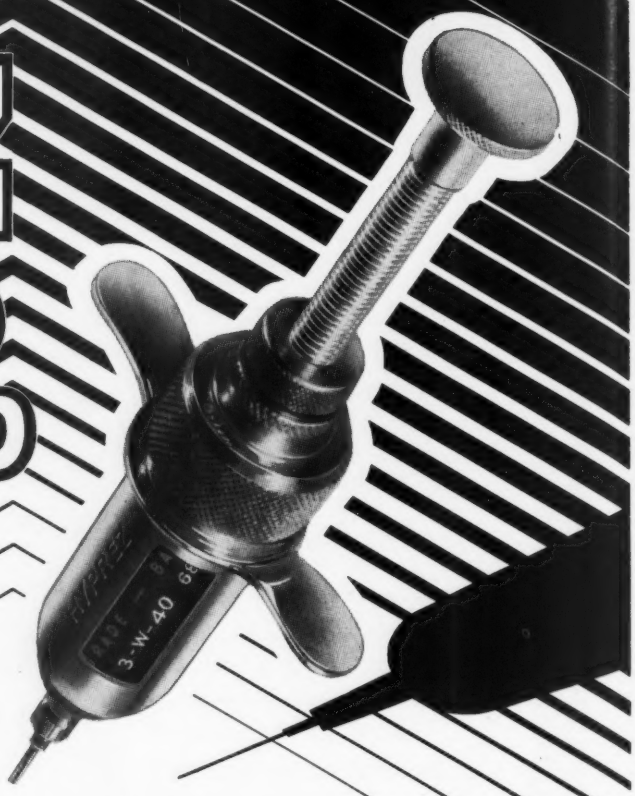

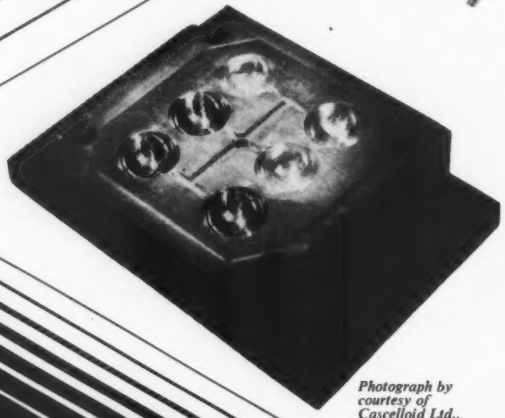

Photograph by courtesy of Cascelloid Ltd., Leicester

HYPREZ

is widely used for the finishing of plastic moulds, as in this instance which clearly indicates the degree of finish obtainable with consequent improvement both in mould life and finished product.

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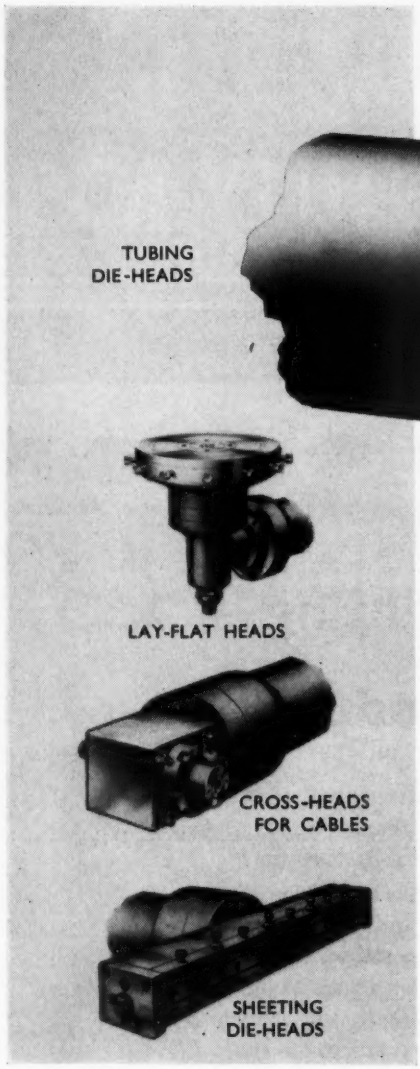

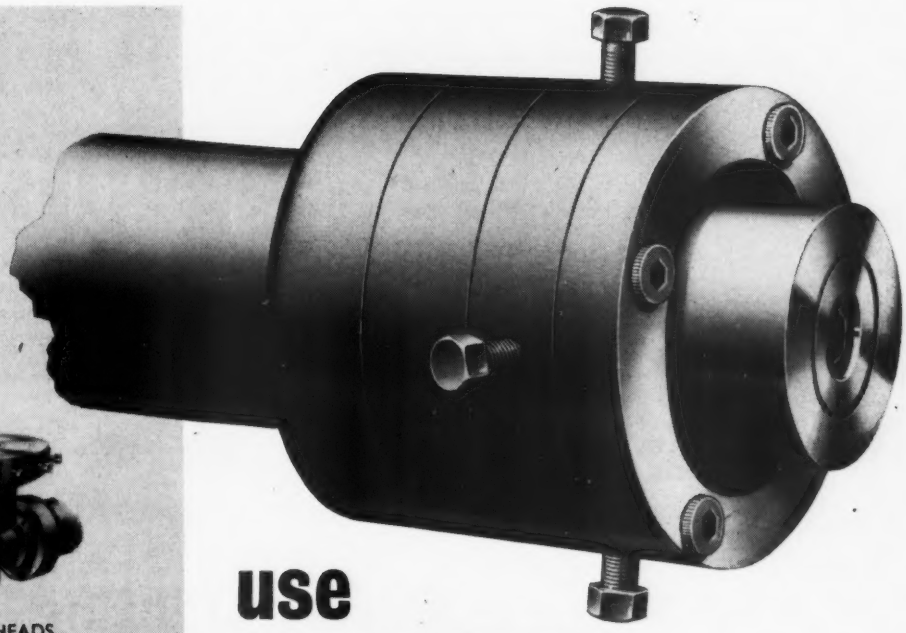

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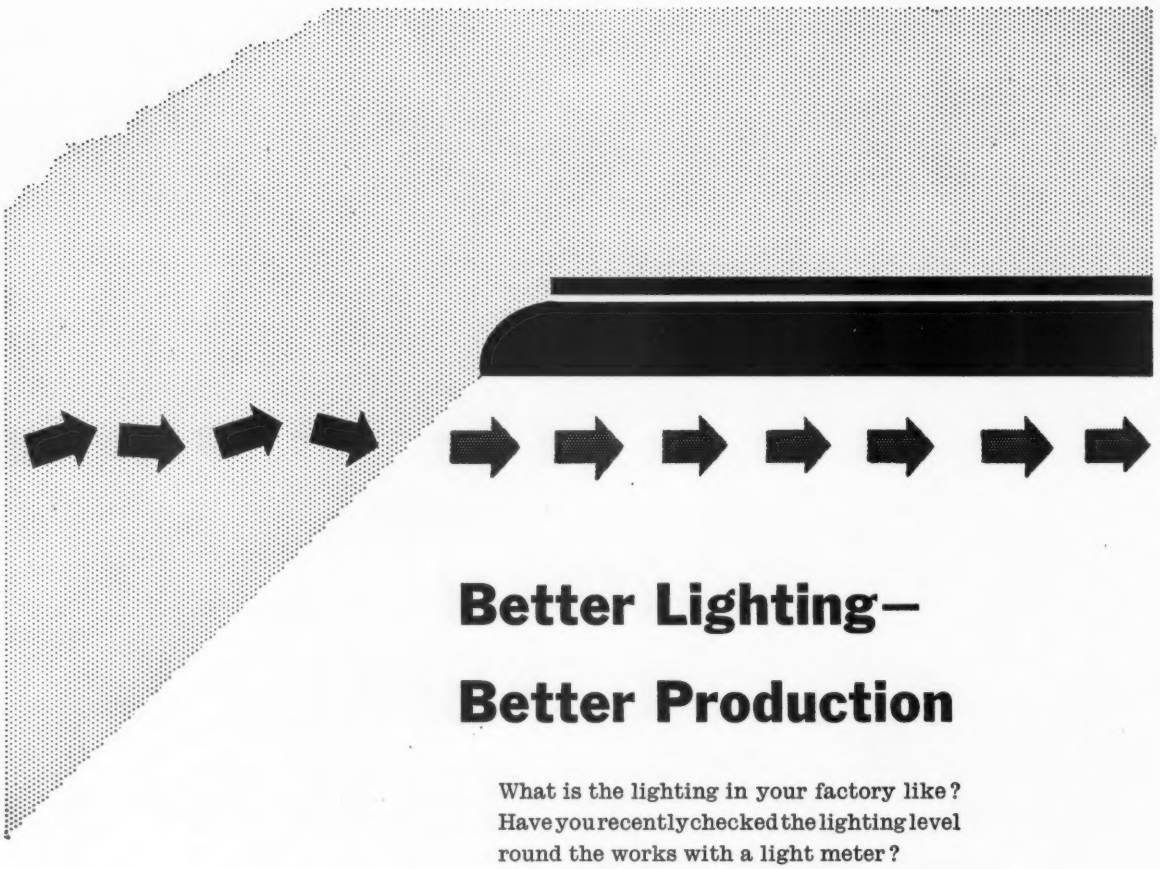

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The *right* lighting has a significant effect on the speed and accuracy of production. When its strength, position and type is suitable for each job the craftsman can give full play to his skill, and the works engineer can do full justice to his shop.

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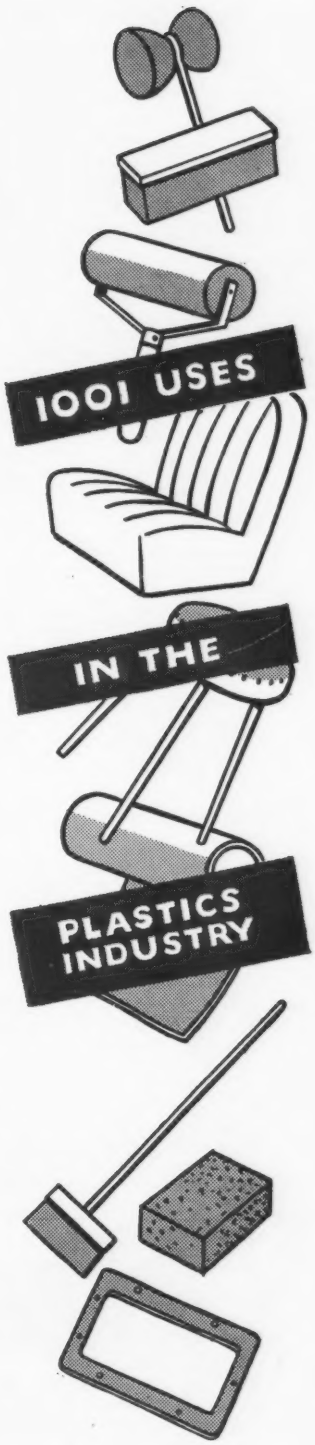

This versatile cellular material is ideal for use alone or in combination with plastics of many different types.

Enables the manufacturer of moulded plastics to extend his range of fancy toilet and domestic goods.

May be combined to P.V.C. for use by the motor trade, handbag makers, floor covering manufacturers, etc.

It can be welded to P.V.C. sheeting by high-frequency welding plant.

Is chemically inert. Is not affected by plasticizers and prevents migration. Is non-toxic and non-silver-staining.

Supplied in sheets, rolls, blocks, cut shapes, strips, pieces, etc., to customers' requirements.
Various densities available in a wide range of attractive colours.

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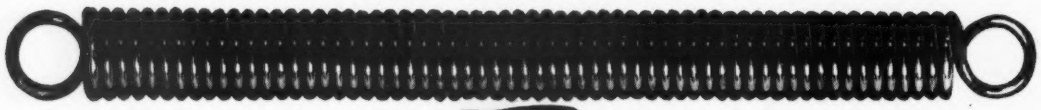
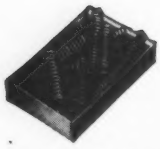
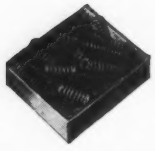
VOLCREPE LTD., "VOLAPRENE DIVISION"
GLOSSOP, DERBYSHIRE
Telephone 497 Glossop



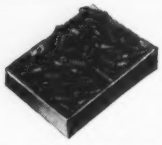


No. 760. 3 doz. Assorted Light Compression Springs 1″ to 4″ long, 22 to 18 S.W.G., ¼″ to ½″ diam. 6/6 each.

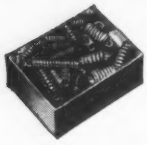


No. 98A. 3 doz. Assorted 1″ to 4″ long, ⅛″ to ¼″ diam., 19G to 15G. 5/6 each.

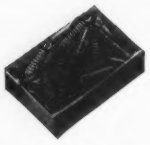
No. 757. Extra Light Compression, 1 gross assorted, ⅛″ to ⅜″, ¼″ to 2″ long, 27 to 20 S.W.G. 15/- each.



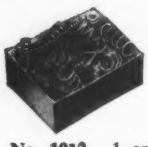
No. 388. ½ gross Assorted Small Expansion Springs. ¾″ to 1½″, 18G to 21G. 9/6 each.



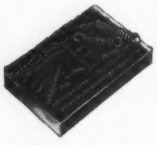
No. 758. Fine Expansion Springs. 1 gross Assorted ⅛″ to ⅜″, ½″ to 2″ long, 27 to 20 S.W.G. 15/- each.



No. 466. ½ gross Assorted Small Expansion Springs ⅜″ to 1½″ long, 3/32″ to 3/16″ diam., 21G to 24G. 6/6 each.



No. 1013. 1 gross Small Coil Compression Springs, ⅜″ to 1½″ long, 3/32″ to 7/16″ diam., 24G to 19G. 6/- each.



No. 753. 3 doz. Assorted Light Expansion ½″ to ½″ diam., 2″ to 6″ long, 22 to 18 S.W.G. 10/6 each.

No. 1024. 20 Compression Springs 12″ long. ⅛″ to ½″ diam., 24G to 18 G, suitable for cutting into shorter lengths; and 30 Expansions 1½″ to 12″ long, 5/32″ to ⅛″ diam., 22G to 16G. 24/- each.

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22″ × 24¼″ DIE PLATES

DOUBLE-SHOT MECHANISM FITTED

C537

This machine is self-contained and hydraulically operated with a choice of manual-, semi- or fully-automatic operation.

Easy to operate and capable of maintaining high rates of production.

Double-shot mechanism gives a form of preplasticising on normal weight mouldings, or increases the machine capacity to 6 oz.

A new-type parallel construction heater unit is fitted and equipped with ceramic heater bands to give high plasticising capacity.

Full details of this and other injection moulding machines we can offer will be sent on request.

Sole Agents United Kingdom

This illustration does not show the floor-mounted panel which houses the Cambridge regulators, timers and control relays.

AD212

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to their ever widening circle of friends
throughout the world

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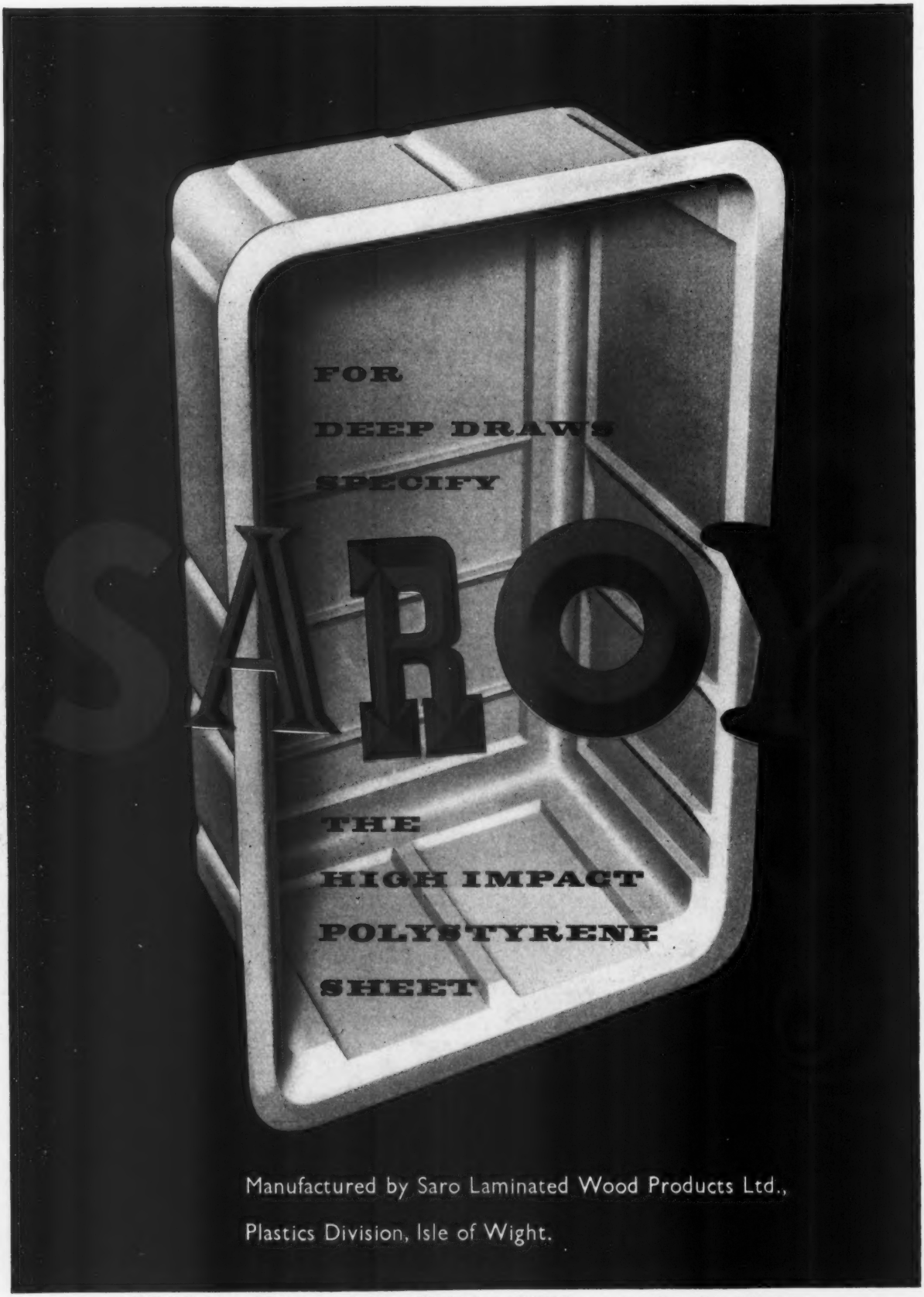

● *This Refrigerator Liner, made from ·125" thickness SAROY, measures 19½" x 33½" x 12¾" deep.*

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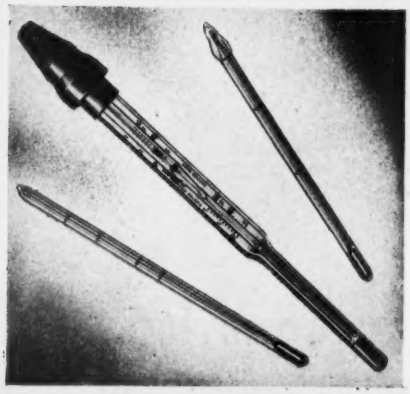

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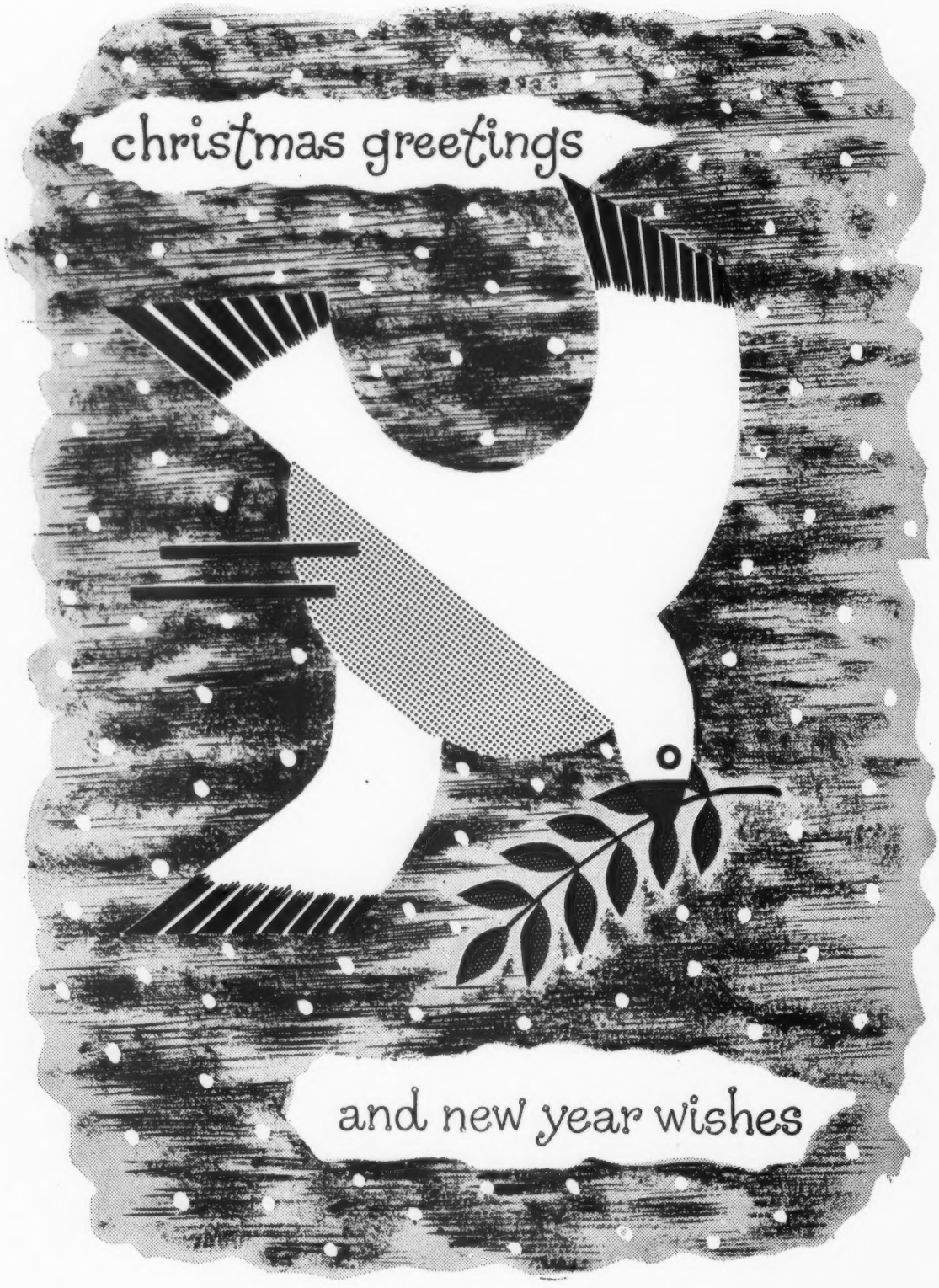

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LEA PARK WORKS · PRINCE GEORGE'S ROAD · MERTON ABBEY · LONDON, S.W.19

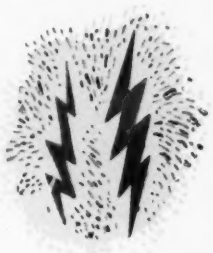
A motorist way down in Bicester
Was hailed by an expert, Hey Micester!
If you listen to me
I think you'll agree
That PVC makes an effective, economical and easy to fit petrol tubing

Father Christmas was terribly worried
When to package his presents he hurried
So he spoke to a pal
Who was at Lorival
And learned that PVC sheeting would be an effective, economical, moisture-and-chemical-proof answer to his packaging problems

Some more limericks — from the lively lads at Lorival...

A keen, conscientious ragazzo
Was thinking about his terrazzo
This problem of flooring
Would be very boring
Were it not for the incontrovertible fact
that PVC makes an effective, economical, easy-to-fit and wholly reliable flooring strip
for use with terrazzo flooring

Said Dante engulfed in the fire
Of the Inferno while plucking his lyre
Six hundred years hence
Any fireman with sense
Will specify PVC
for a remarkably effective, tough, durable fire hose lining



Said the Amp
to the Volt with a titter
No wonder, my dear, you're so bitter,
This leak they can mend
In a moment, old friend
Because PVC makes an effective, economical insulating material for all sorts of electrical work

PVC, in the hands of Lorival's lively lads, can do a lot of jobs better and cheaper. Why not drop a line to Lorival? Then you can get together with the lively lads and figure out ways and means of using PVC to your advantage.

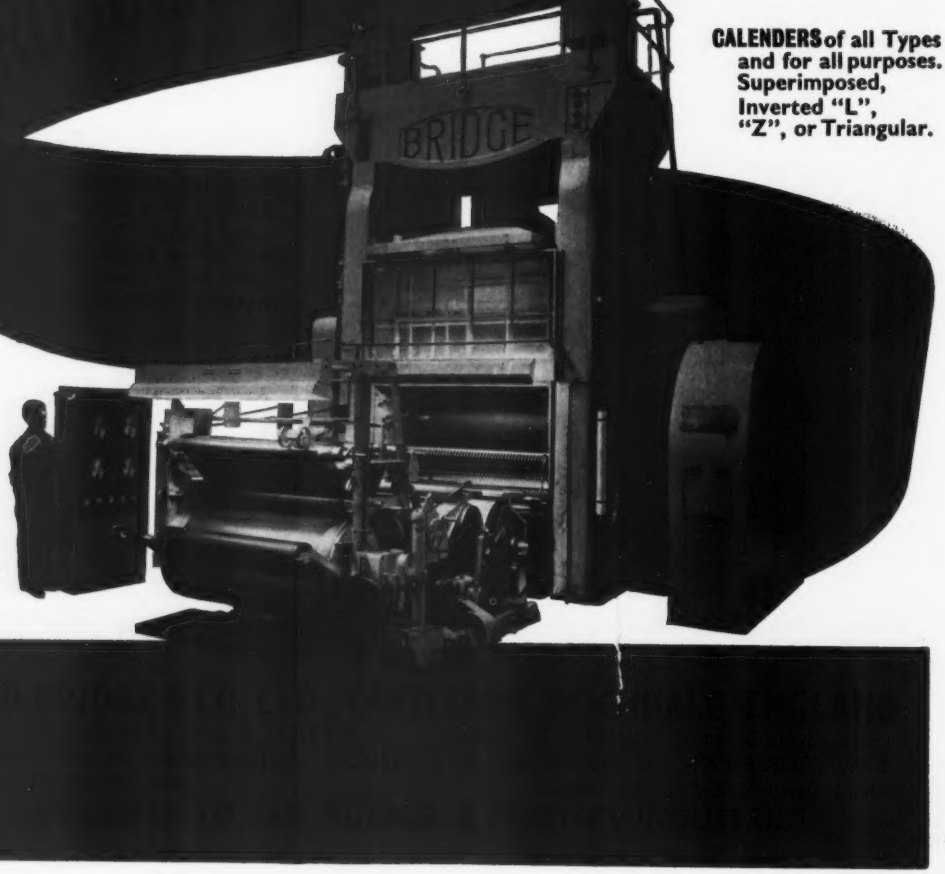
LORIVAL PLASTICS

United Ebonite & Lorival Ltd., Little Lever, Nr. Bolton, Lancs.

L64

efficiency compo

BRIDGE



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'PERSPEX' acrylic sheet makes the best signs in any language. It is a very handsome material, extremely tough, light and easy to handle, and will stand up to weather conditions in any part of the world.

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'Perspex' is available in clear or opal sheet or in a wide range of transparent, translucent and opaque colours.

Illuminated 'Perspex' sign for 'Esso' Petrol, made by Tek Plastics of Toronto, Canada.

Three-dimensional 'Perspex' sign for Shell at The Hague, Holland. Manufactured by Thermo-Plastics Limited, Dunstable, England.

'Kolynos' Toothpaste sign, manufactured and installed in Peru. The sign is lit internally.

'PERSPEX' *is the registered trade mark for the acrylic sheet manufactured by I.C.I.*

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

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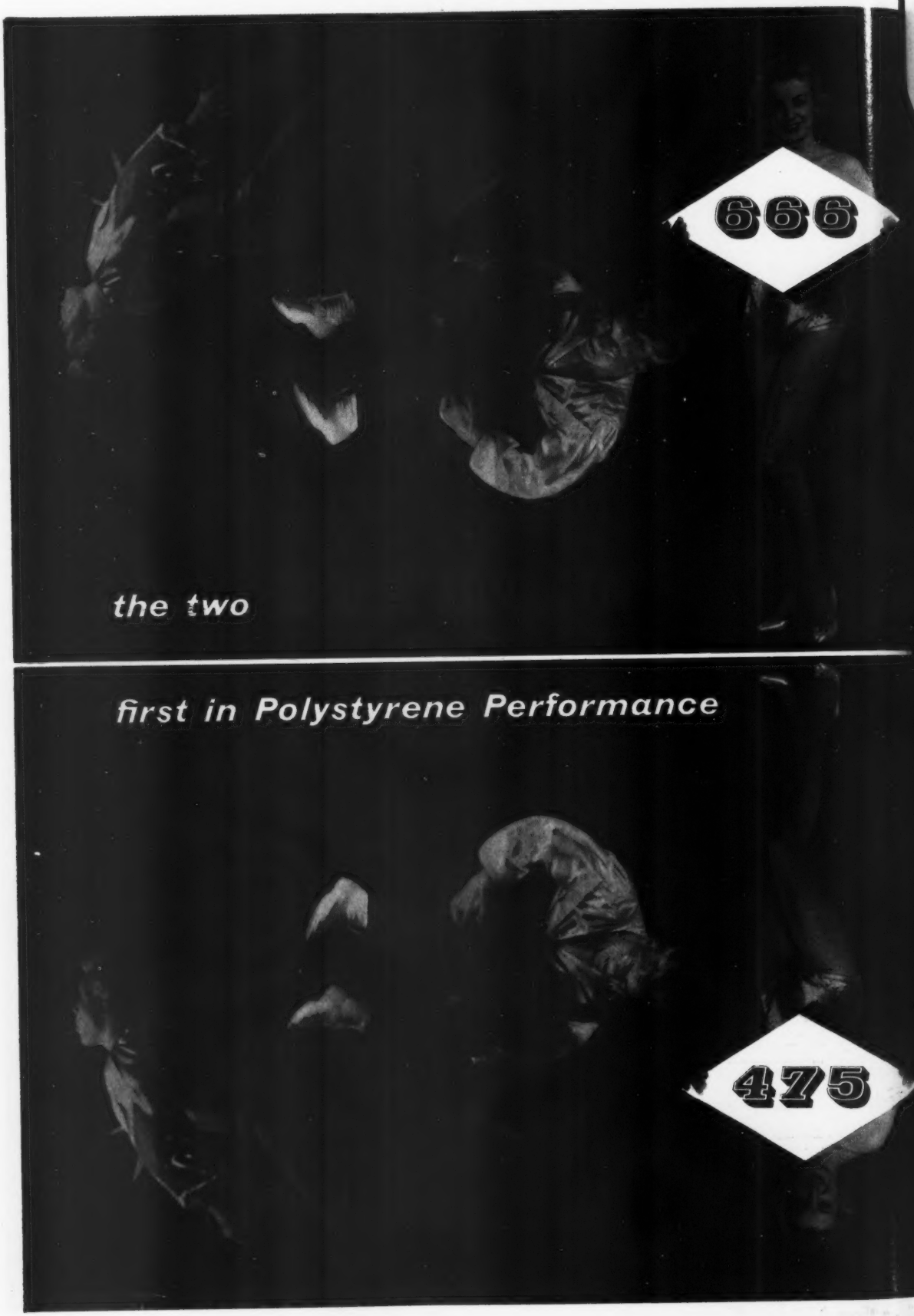
P.60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the two
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475

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The sparkling clarity of Styron 666 opens new prospects in the packaging of pharmaceuticals, cosmetics, perishable foodstuffs and many other retail items. For extra tough containers Styron 475 is ideal.

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Distrene Limited employs the most advanced manufacturing techniques in the new Styron plant at Barry, Glamorganshire This has resulted in the production of polymers of the highest consistency. Easy to mould and easy to form. Styron gives increased production and lower reject rates.

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Polystyrene

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Styron production techniques ensure consistency of all essential properties over extended periods of use. Styron has low thermal conductivity and low specific gravity . . . is hygienic, non-toxic, water resistant and rust-proof.

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xtra toughness is
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in types of packaging.
Styron 475 is also ideal for extrusion into sheet for vacuum forming.

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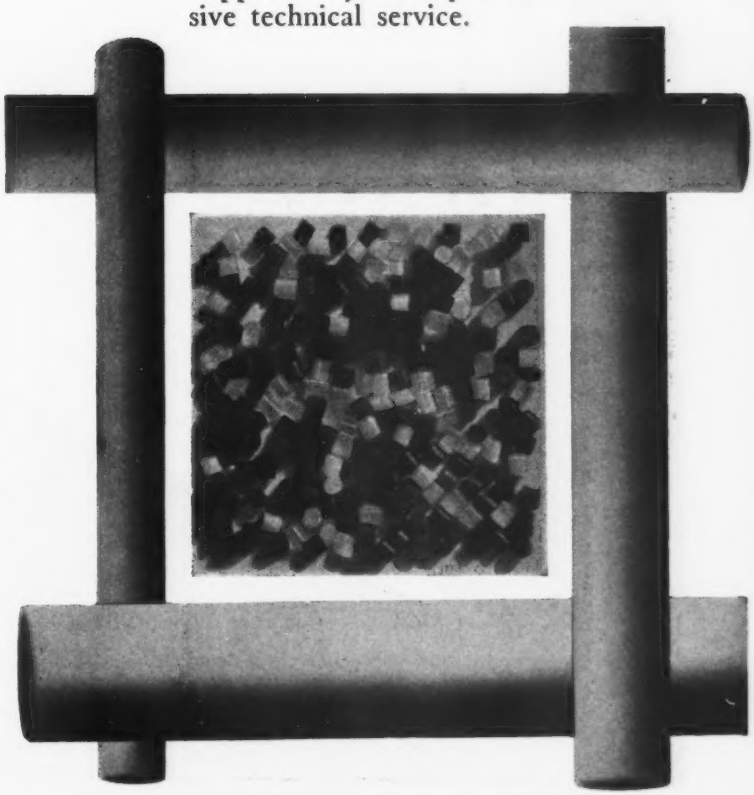

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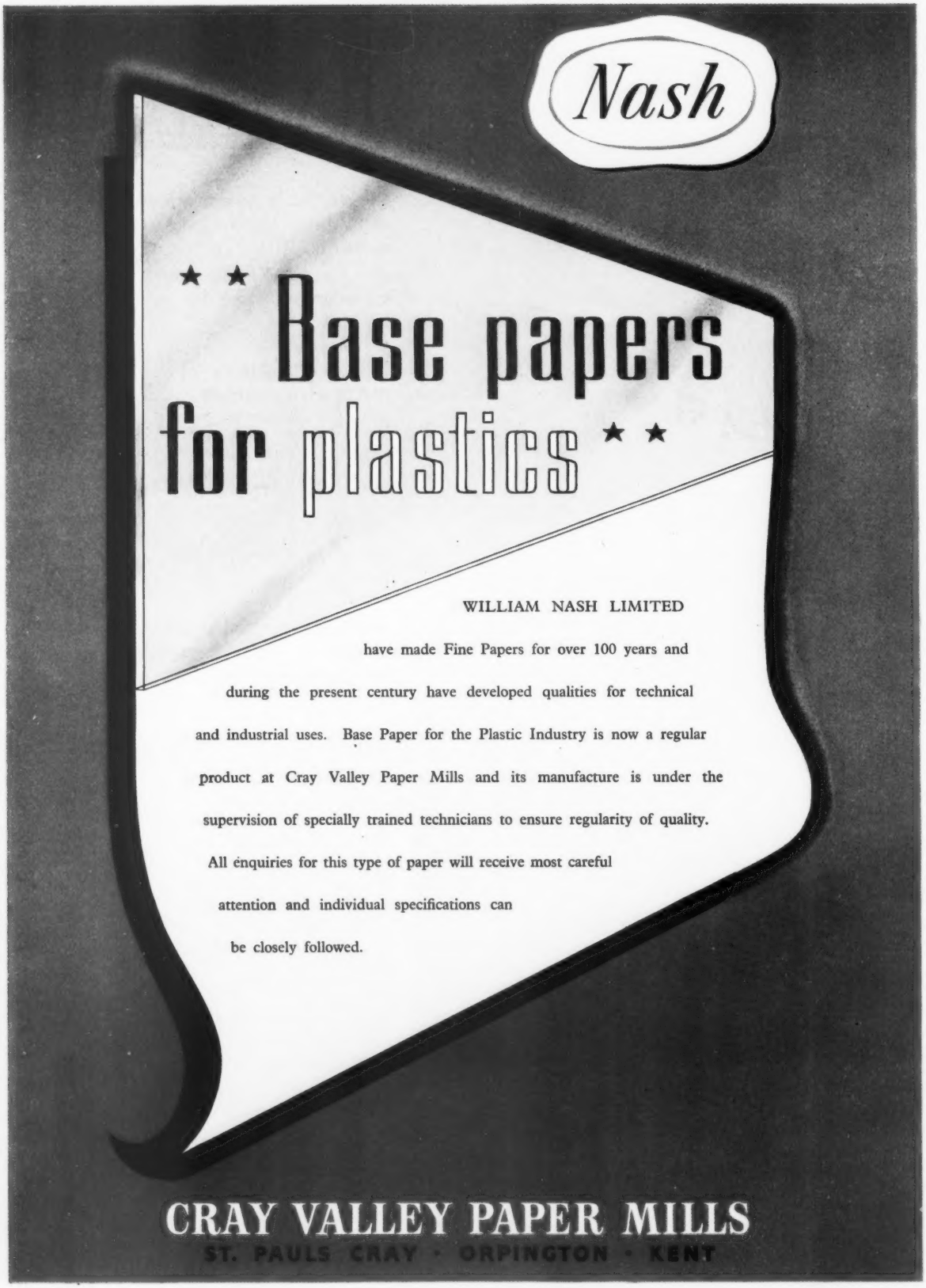
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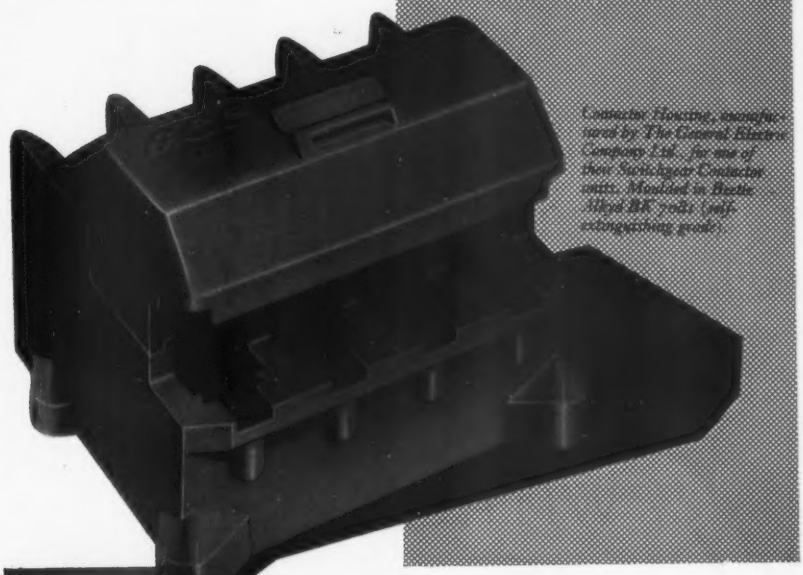

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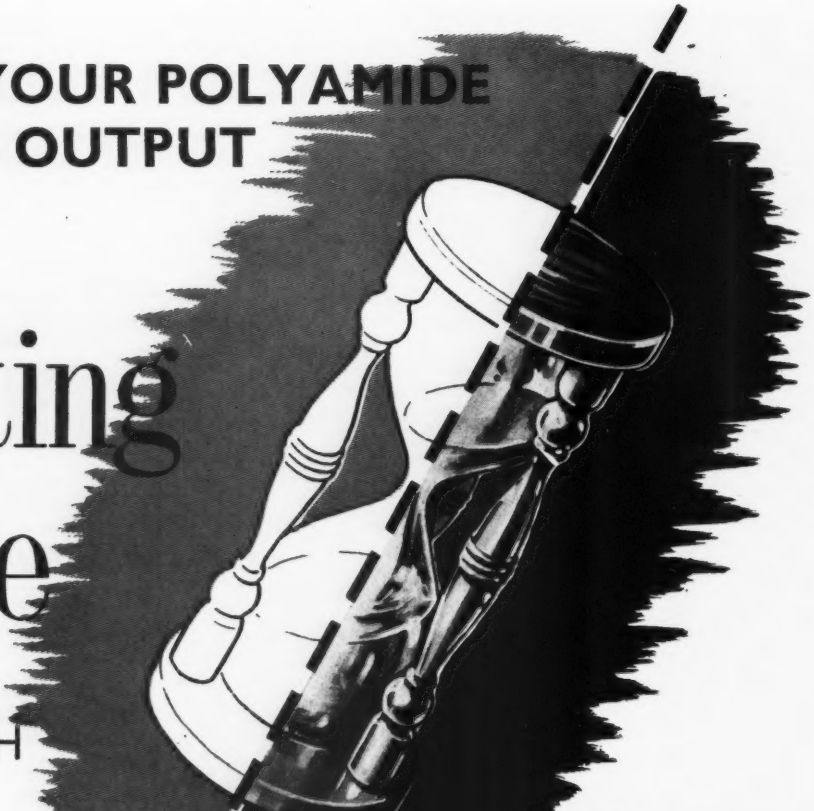

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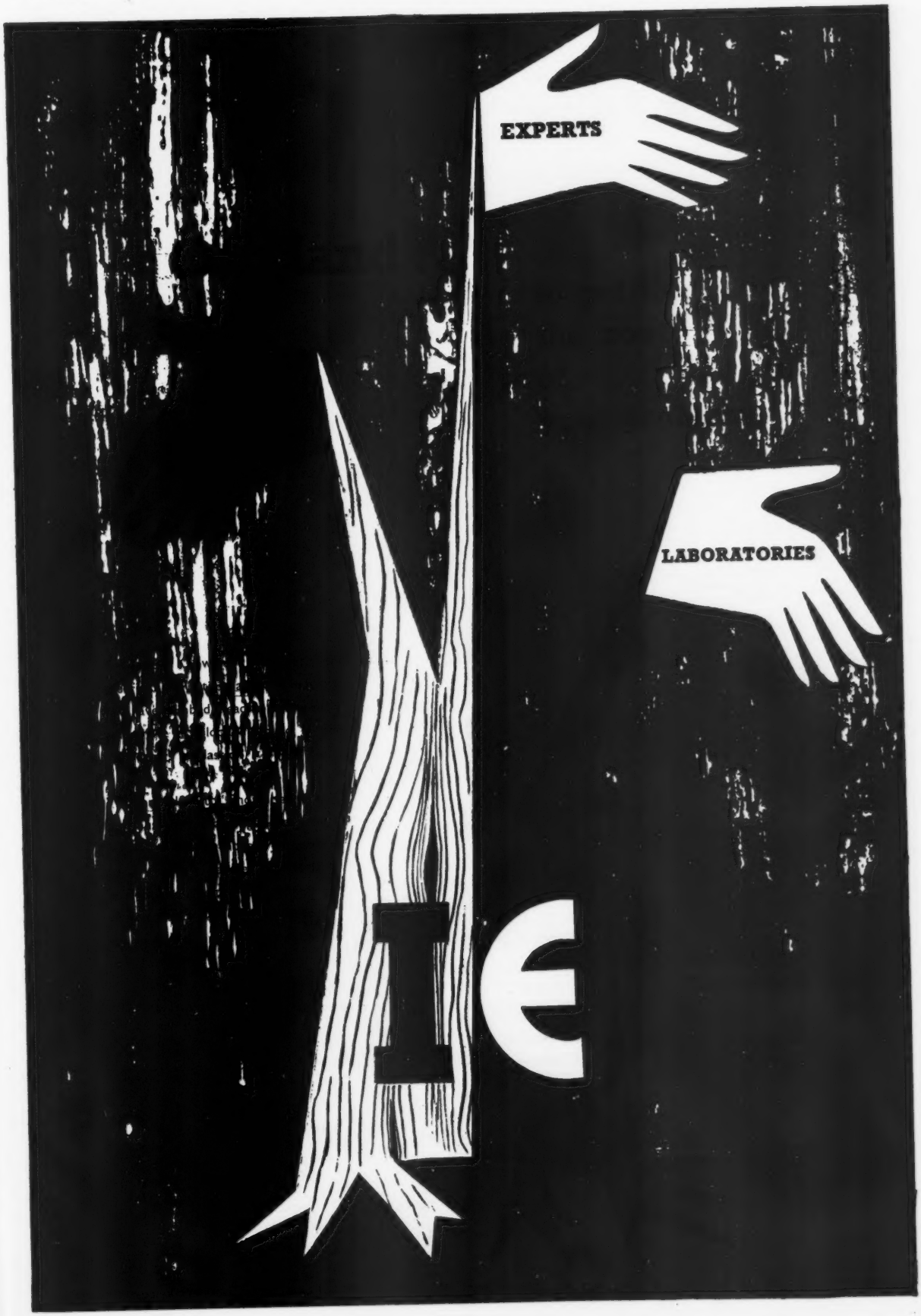
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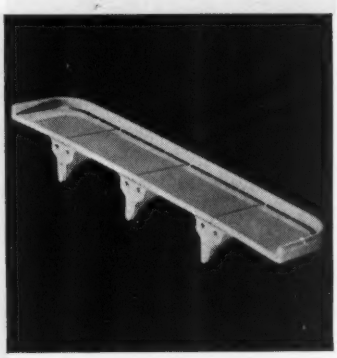

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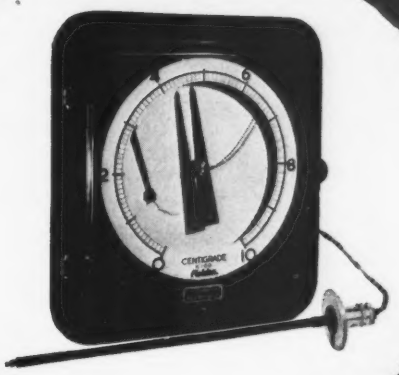

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—material progress

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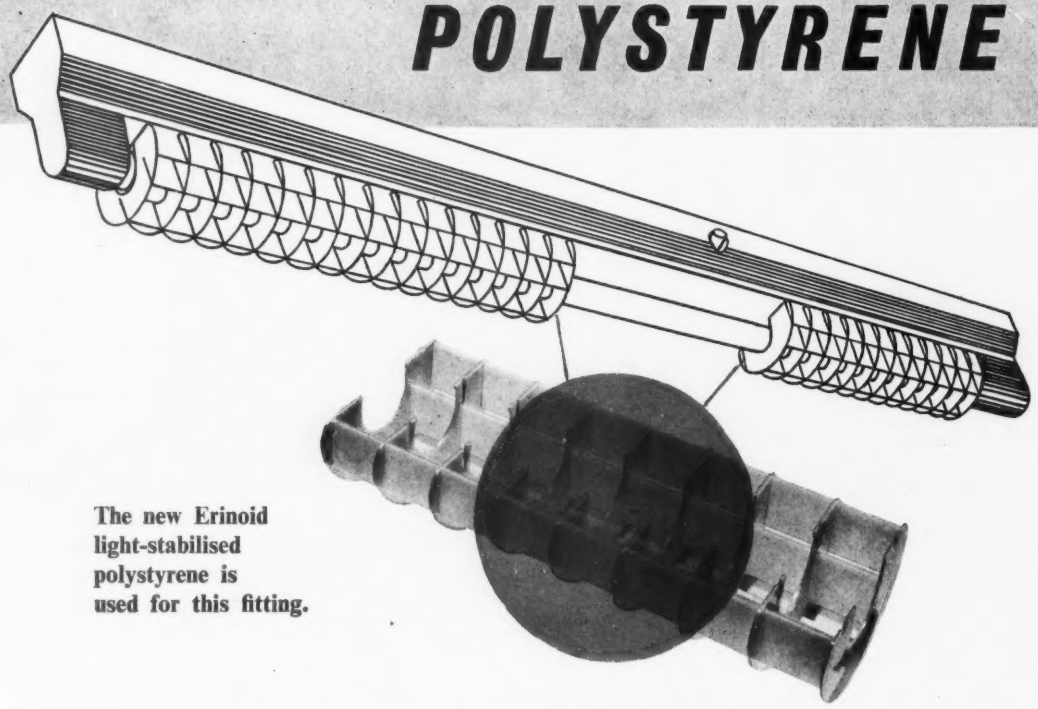
Erinoid

POLYSTYRENE



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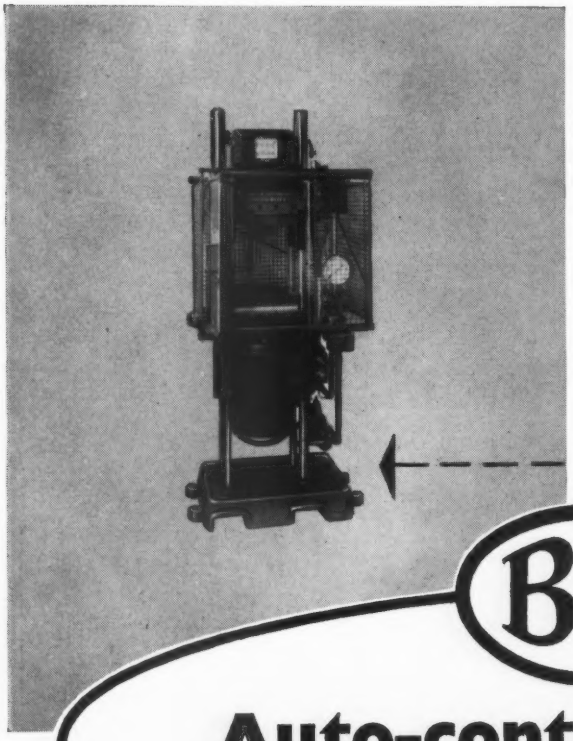

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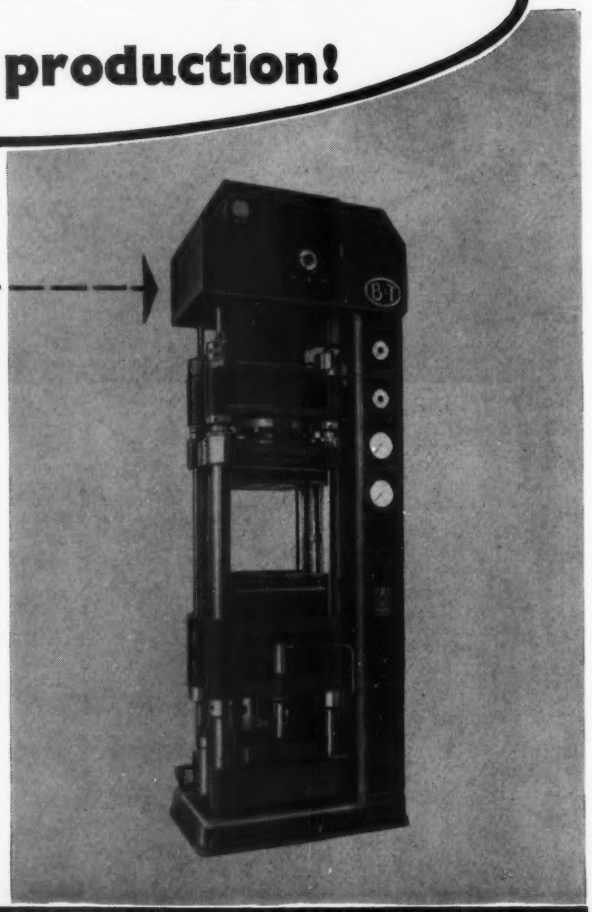

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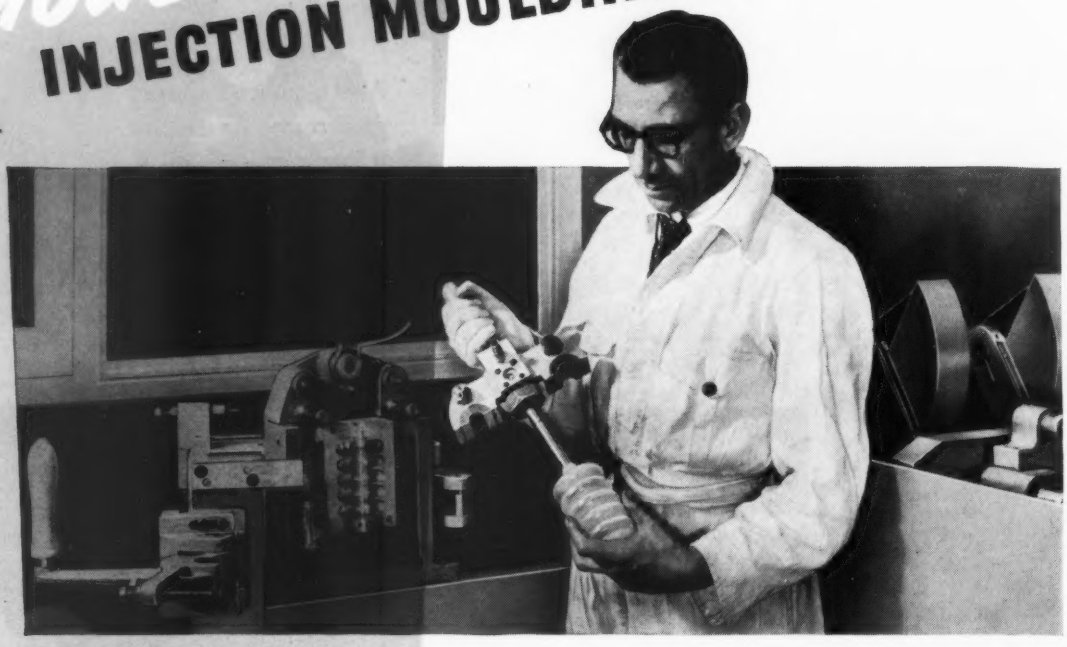
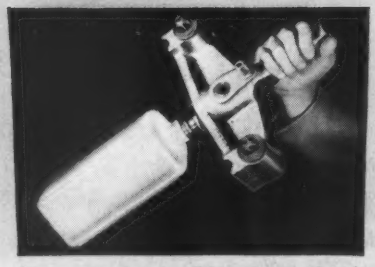
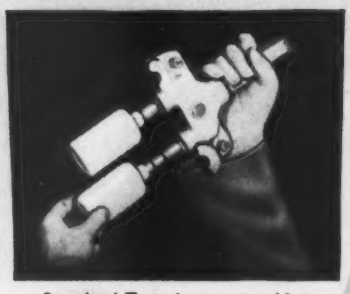




Blow stick showing 2 litre square bottle



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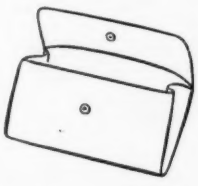
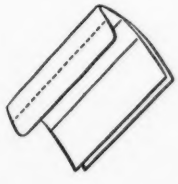
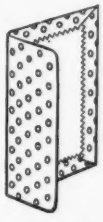


The transparent bag



Rayon inner lining



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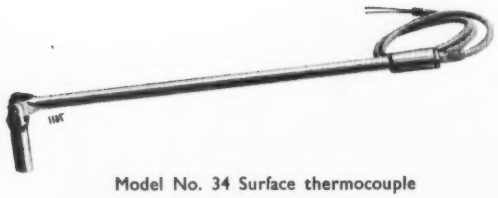

Model No. 34 Surface thermocouple

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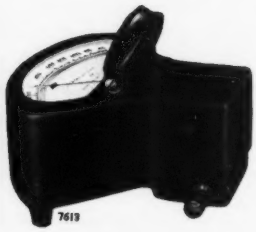
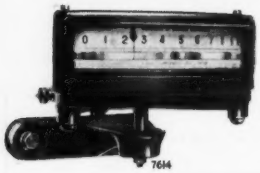


WALL TYPE INDICATOR



Any of the above indicators may be used with Cambridge Surface Thermocouples. **Demonstrations may be given, without obligation, in your own moulding shop.**

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.
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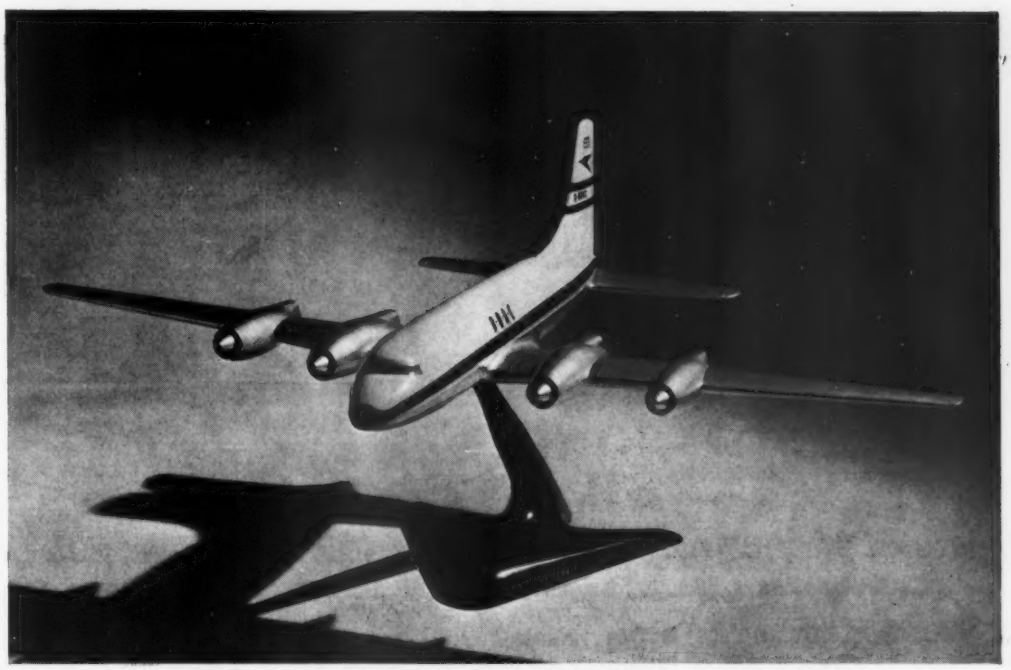

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Plastics

VOL. XXI No. 231 DECEMBER, 1956

EDITORIALS

The Swedish Plastics Industry

LET us look at Sweden and its plastics industry. We had the opportunity of doing so on the occasion of the Swedish Plastics Federation's annual conference and its exhibition held in Stockholm from October 29 to November 1, which also coincided with the Federation's 10th anniversary. Here are a few dry but illuminating facts.

Sweden is a country of about 7,000,000 inhabitants only, yet in consumption of plastics per head of population claims to hold second place in the world after the U.S.A. Production of plastic raw materials has climbed from about 1,000 tons in 1939 to about 30,000 tons in 1956. The Swedish Plastics Federation has 275 members, a figure which is very near that of the British Plastics Federation!

If we couple this with the fact that the Swedes are a race with an exceptionally high standard of living, an acute and balanced understanding of the making and the value of material things and an exceptional appreciation of beauty in them, we may discover some reason for the success implied in the foregoing figures. To this we must add one other fact: in spite of competition between many of them the members appear imbued with the importance of coherence and collaboration in matters of basic principles, especially that most important one of attaining the highest quality possible in moulded and fabricated goods. From our visits to the exhibition we believe this principle has been accepted more often than not. The excellent informative labelling on so many exhibits was noteworthy.

Although the 30,000 tons raw material production given above includes nitro-cellulose, phenolics and laminated sheet, urea and melamine resins, polymethyl methacrylate, polyvinyl chloride, polyester resins and glass fibre, there is a considerable importation of plastics raw materials and half-finished goods from abroad. Hence it was no surprise to see among the 70 exhibitors at the "We Look at Plastics" Exhibition, a number of British and other foreign stands.

The Technical Conference itself was also a major achievement, quite in concert with what we have already said. The whole floor of a very large hotel had been taken and over a period of four days in three large halls, 21 sections of the industry delivered and discussed 85 papers. In addition 11 films were shown. Some 600 individuals attended the Conference, 36 papers were delivered by English speaking technologists, British, American and French, 31 were delivered in German, the remainder in Swedish. We hope to publish some of them in this journal.

The Golden Room

THE high-light of the Jubilee was undoubtedly the reception, dinner and ball given to some 700 guests, members and their wives at Stockholm's Town Hall in its breathtaking Golden Room. We are sure nobody who was present will ever forget this impressive occasion and we doubt if any other nation could hope to emulate unless it were the French if they could use the famous Hall of Mirrors in the Palace of Versailles for it. London's Guildhall would seem rather dreary beside it, for the Golden Room is *really* a vast golden hall with its immense walls of mosaic covered in gold leaf and decorated with Grecian figures, mounting more than 70 ft. to the roof. That the Swedish Plastics Federation members were permitted to hold their Jubilee dinner in it and to dance in the equally vast adjacent Blue Room is a very remarkable thing; it speaks eloquently of the willing collaboration that exists between the Mayor and his Council on the one hand and Swedish industry on the other.

The President of the Federation, Mr. Harry Nystrom, greeted the guests with the warmest of compliments, for his welcome passed easily and fluently from Swedish to English, to French and to German. And as a thoughtful gesture to the large British contingent present, our own Charles Waghorne was invited to respond to this welcome for the guests which he did with his usual aplomb, good humour and heart-felt thanks.

Swedish hospitality is overflowing and has, too, a remarkable warm quality and understanding. Every foreign female guest was placed between two male members of the Federation able to speak fluently her own language and each male guest was similarly entertained by two Swedish ladies. And to cap it all, to our delight, during the dinner all the Swedes present sang lustily in English, with "Happy Birthday to You," "Coming Thro' the Rye" and "Auld Lang Syne" intermingled with numerous and fervent greetings of "*Skål*!"

Skål! to the Swedish Plastics Federation. *Skål*! to its President, that great personality Mr. Harry Nystrom, whose amazing energy and overflowing kindness was clearly responsible for this remarkable Jubilee. *Skål*! to all its members and wives who gave us a happy memorable time, and yet another *Skål*! to Erik Janson, the Federation's Secretary who worked so hard and so ably behind the scenes.

How we wish the British Plastics Federation, perhaps combined with the Plastics Institute, would reciprocate by holding its own Conference and Exhibition with similar energy and spirit.

Paris Conference

LITTLE more than two weeks after the Stockholm Convention, yet another and much larger took place in Paris—larger because it was the 29th International Congress Industrial Chemistry, the subjects of discussion coming under the headings of Corrosion, Chemical Engineering, including Nuclear Engineering, Rubber and Plastics, and General Chemistry including Measurement and Control. In addition the bienniel exhibition took place on 22nd November to 3rd December in two vast halls at the Porte de Versailles, one of which was devoted to rubber and plastics, and the other to chemical plant, chemicals and a great array of chemical apparatus and measuring instruments.

Limits of space and time prevent us from reporting on this Conference in this issue, but it will interest readers to learn that of the 1,000 exhibitors at the exhibition 700 were French, 132 were German, 60 were from Great Britain, 59 from the U.S.A., and 30 from Canada.

Plastics and Oil

CRYSTAL gazing is the fashion at this time of the year, a branch of science we have long mistrusted. Events move too rapidly today to make generalized long-range forecasts anything more than interesting flights of fancy.

Something may be said, however, for an appraisal of the

year that is ending, for it has been remarkable for so many reasons. Few companies have been free from problems of one kind or another and we are now, at this point in time, passing through an international crisis as grave as any during the past 10 years. Our oil supply is threatened at a time when more than ever a firm supply is essential.

The growth of the petrochemical industry in Britain, hesitant at first, has, during the past 12 months taken an immense leap forward. Of the many plants either completed or in course of erection, we need only name Grangemouth, where styrene monomer production has been increased to 30,000 tons, Fawley, where Monsanto are to make polythene, Grangemouth again, where a polythene plant of capacity 11,000 tons per annum is to be built, Partington, where Shell Chemicals are to make polythene of the Ziegler type, and latest of all, the purchase of the option on a site at Londonderry, Northern Ireland, by the British subsidiary of E. I. du Pont de Nemours, for the manufacture of neoprene.

With plants now operating, or scheduled to come on stream by 1959, the total output of polythene and polystyrene will be in excess of 155,000 tons a year. And we must remember that a large proportion of this formidable tonnage is based on petroleum derivatives.

Therefore, whilst industry has at the moment every cause to ponder the grave issues confronting it, the basic convictions of science and finance remain unchanged. The policy of steadily increasing capital investment in new plants, based on oil, has not yet undergone any major modifications, and this example may serve to underline the spirit of this year. With all the setbacks and deterrents with which we have all had to cope, we look forward to 1957 with hope, and, in view of the continued startling growth of our industry, with some excitement.

Moulding Powder and Shot

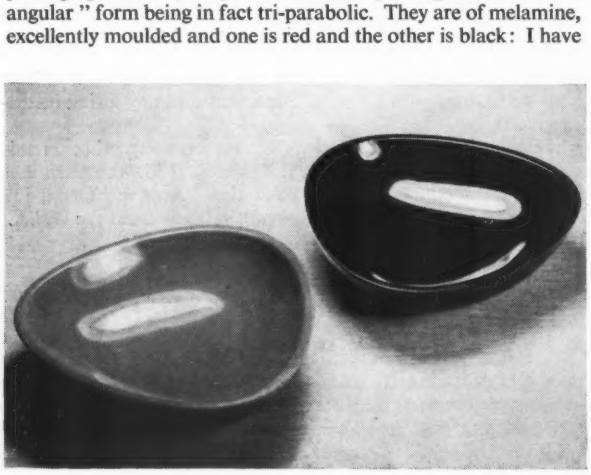
As you will have noted from the above, it has been impossible to report at all yet on the Paris Conference. But I must point out one little thing I spotted on a small stand. Gachot et Cie have long made metal taps and other components, but in recent years have specialised in P.T.F.E. Unless somebody can tell me they've already seen it, they make a little job which looks to me as being completely novel and ingenious. It is P.T.F.E. " wool " for use as a tap and pipe joint under acid and high temperature conditions. As it would be most unlikely that it is extruded and since under a magnifying glass it looks flat and slightly uneven in thickness (I should say it is under 1/1000 inch thick) I suppose it has been turned from a rod of P.T.F.E. with a very fine tool. Two other jobs on this stand were P.T.F.E. balls for valves and flexible tube connections made by close spiral cutting of P.T.F.E. tubing. The novel approach to the utilization of this material by this French concern opens up many interesting lines of development.

P.T.F.E. "wool" for joints

* * *

Almost every foreigner I talked to in Stockholm had, above all, one topic of conversation—the wonderful designs of Swedish glass, silver and wooden objets d'art and the extraordinary number of shops and stores that displayed them. And how delighted we all were at being presented after the dinner and ball at the Golden Hall, with the only beautiful ash trays I've ever seen. They may of course, be trinket or sweet trays. As will be seen from the photograph below, they are remarkably designed, the " triangular " form being in fact tri-parabolic. They are of melamine, excellently moulded and one is red and the other is black: I have never seen black look so full of colour. This is obviously partly due to the finish but more to the complete absence of angles. It is the perfect confirmation of what Mr. Woodfull said in his excellent paper: that curves are essential in plastic design where possible, for they reflect light from all positions. The trays are large (about 7 inches at the widest point), thick (5 mm. minimum) and weighty (about 8 ounces).

Design in Excelsis



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On 28th November at the Institute of Mechanical Engineers an "Automobile Division" debate was held on the topic " There is no future for laminated plastics in automobile body construction." The speaker for the motion was Mr. R. Robertson, while Mr. D. S. Mahon spoke against the motion. No formal paper was presented and no record of the debate was kept. In view of the special conditions under which the debate took place, I won't comment on it for the time being, except to say that the delivery of a paper with this title at all, will rouse considerable interest in wider fields, and to add that it's my conviction one cannot impose a 1900 technique on to a 1956 industry.

Plain Words at last?

* * *

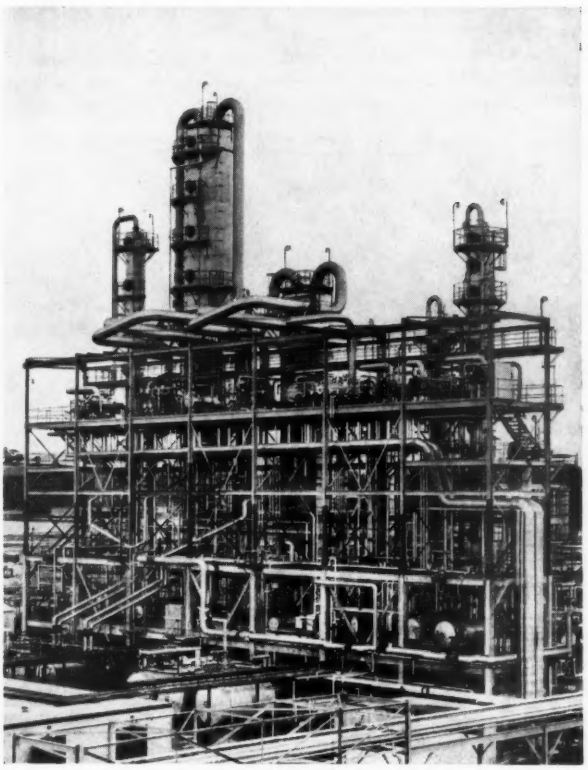
Russia and China have long stimulated the thoughts of Western manufacturers as markets of great possibilities. For various reasons, political as well as economic, free trading virtually ceased with the outbreak of World War II, and little interchange has taken place between the Soviet areas of influence and the West. It was therefore a courageous and imaginative decision that was taken by H. Bridge, J. Lesser and R. Sternberg, who, in consultation with the British Plastics Federation and the Board of Trade, sought Russian permission to make a tour of Soviet factories. The object was to explore the possible outlets for British plant, materials, and moulded products. The team have returned with a fascinating report, the first appraisal by western eyes, of the U.S.S.R. plastics industry of today. We have much food for thought, as a result of some of the team's revelations. Moulding shops of 3,500 employees, research centres covering twelve acres, and many other items, show that Russia is moving rapidly towards a parity with Britain, Germany, and the U.S.A. Perhaps the most sensational disclosure is that bonus incentive schemes and display boards outside factories announcing the leading workers' names, parents' names, and children's names, are some of the reasons why the Russians work hard. As Mr. Lesser said, " If you break a production record they practically put your name up in lights."

The Curtain Lifted

DOGSBODDY.

Styrene Production at Grangemouth Extended

The new section of the Forth Chemicals Ltd. plant came on stream recently. Total styrene monomer now produced is in excess of 30,000 tons per annum.



STYRENE, a monomeric material having important and diverse applications in the plastics and other industries was, prior to 1925, a laboratory curiosity. Between that date and 1935, I. G. Farbenindustrie in Germany, and the Dow Chemical Company in America, investigated both the manufacture of the monomer and the various polymerization processes, with great commercial success, and by the end of the late war, polystyrene as a moulding composition, and styrene monomer as a basic chemical for synthetic rubber, were in large tonnage production in both Germany and the U.S.A. 1944 production in the latter country was in the order of 200,000 tons.

With the end of the war, a demand for polystyrene for injection moulding arose in Britain, and the first step was the setting up of a number of polymerization plants (Monsanto Plastics Ltd., B.X. Plastics Ltd., Styrene Products Ltd., British Resin Products Ltd., etc.) based on monomer imported from Germany and America. By this means polystyrene manufacture grew to a figure of 18,000 tons a year by 1953, at which time a styrene monomer plant went on stream at Grangemouth, Scotland, with a capacity of more than 8,000 tons per year. The demand for polymer continued to grow, however, and it was not long before the supply of styrene monomer made in the U.K. was substantially below requirements.

Plant Extrusion

With this background therefore, we come to the new plant at Grangemouth, opened to the press on November 9. Operated by Forth Chemicals Ltd., the plant is part of a large site on the Firth of Forth; The Grangemouth Refinery, built in 1924, now processes over 2½ million tons of crude oil per year. Forth Chemicals itself is one third owned by Monsanto Chemicals Ltd., and two thirds by British Hydrocarbon Chemicals Ltd., the last mentioned company being jointly owned by the Distillers Company Ltd., and the British Petroleum Company, Ltd.

The new plant, now on stream, produces more than 20,000 tons of styrene monomer a year, making the total plant output in excess of 30,000 tons.

Basic chemicals for styrene manufacture are benzene and ethylene. The former, a coke-oven product, is a liquid brought into the plant by road and rail tanker. Ethylene, obtained from the cracking of crude oil in the British Petroleum plant, is available on the site.

Essentially an alkylation process, benzene and ethylene are brought together in the presence of aluminium chloride as a catalyst, and ethyl chloride as a promoter. Purity of all raw materials is essential; benzene purity is in the order of 99%, total sulphur content being not higher than 0.10%.

The reaction may be described as follows:—If 1 mol of ethylene comes to equilibrium with 1 mol of benzene, the resulting product contains by weight 18% of benzene, 51% ethyl benzene, and 31% polyethyl benzenes. The ethyl benzene is then subjected to a dehydrogenation process, an endothermic reaction, run at about 630°C. Super-heated steam is employed, and catalysts based on magnesium or iron oxide appear to be favoured. American dehydrogenation plants have reported ultimate yields of 90–92% at conversions of 35–40% per pass.

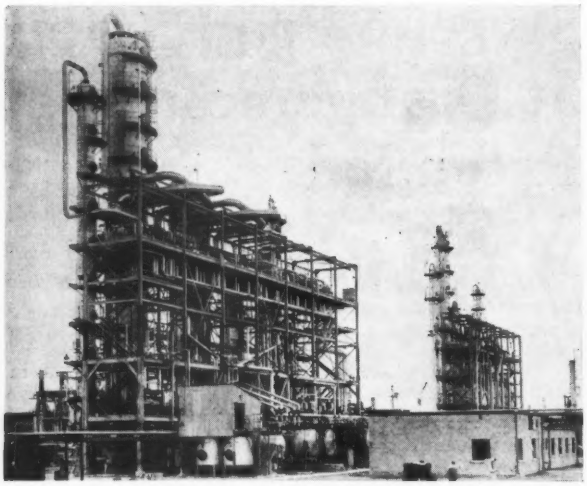
Monomer Purification

The final stage of monomer manufacture is the purification of crude dehydrogenated material, which contains 35–40% styrene. The new plant, designed by the engineering department of Monsanto Chemicals Ltd., contains some of the largest distillation units ever designed and fabricated for the British chemical industry, and great skill is called for in the design and operating of such plants, bearing in mind the fact that the boiling points of styrene and ethyl benzene differ by only 9°C. In addition, distillation of styrene at its atmospheric boiling temperature (145.2°C) is impossible, since polymerization to polystyrene would immediately occur. At 30mm Hg. absolute, the boiling point is 54°C, at which temperature the polymerization rate is less than 0.1% per hour. As a further precaution, elemental sulphur is employed as a polymerization inhibitor.

Mention should be made here of the remarkable progress in control-room design which has been made since the first plant went into operation. Although smaller, the new control room has many additional features, not least of which is the panoramic method of showing the flow system.

A final production factor is the question of shipment. Pure styrene monomer is colourless, having a molecular weight of 104.14, a boiling point of 145.2°C, and a viscosity at 25°C of 0.730 centipoises. Exposure to air will cause rapid oxidation, and in order to maintain purity during transit to the polymerizing plants Forth styrene is protected by a nitrogen blanket during shipment by road and rail.

The monomer has as its major outlet at the moment the injection moulding branch of the industry, for which it is polymerized to polystyrene. The polymer is also widely employed for sheet extrusion, expanded products, etc. Monomeric styrene



The new distillation area, which incorporates some of the biggest distillation columns ever manufactured for the British Chemical Industry. The largest is 140 ft. high.

is also of strategic importance in the manufacture of synthetic rubber, an aspect of the industry now getting under way in Great Britain.

Many other outlets for the monomer are also in process of development in this country, as follows:—

1. Intermediate. It is an intermediate for the manufacture of other essential chemicals, such as dyestuffs, agricultural chemicals and pharmaceutical products.

2. Styrene-Based Emulsions. Emulsions of polystyrene and of styrene-butadiene and styrene-acrylic ester co-polymers have wide applications in the formulation of surface coatings, bonding agents, and adhesives. These emulsions are used as film-forming bases in water paints, and in textiles and paper coatings. They are also used as bonding and laminating agents, and they may be incorporated in waxes and polishes. Non-dusting and water-resistant cement floorings can be obtained by a suitable addition of polystyrene emulsion to the cement mix.

3. Polyester Resins. Suitably catalyzed mixtures of styrene and certain synthetic resins are readily converted into very tough solids. Reinforced with glass fibre, cloth or paper they produce durable laminates and mouldings, the process requiring only low pressure.

Industrial applications include pipe manufacture, moulded plastics, electrical parts, domestic appliances, luggage, boat building and structural components for aircraft and motor transport.

4. Elastomers. Special types of synthetic rubbers made from styrene-butadiene copolymers can be used to reinforce natural rubber, greatly increasing the durability of the finished product. Alternatively these special synthetic rubbers may themselves be produced as foams, films, blocks or slabs, or can be moulded directly into finished products.

Industrial applications include shoe solings, apparel accessories, conveyor belts, electric cable sheathings, sheet flooring and flooring tiles, and mouldings.

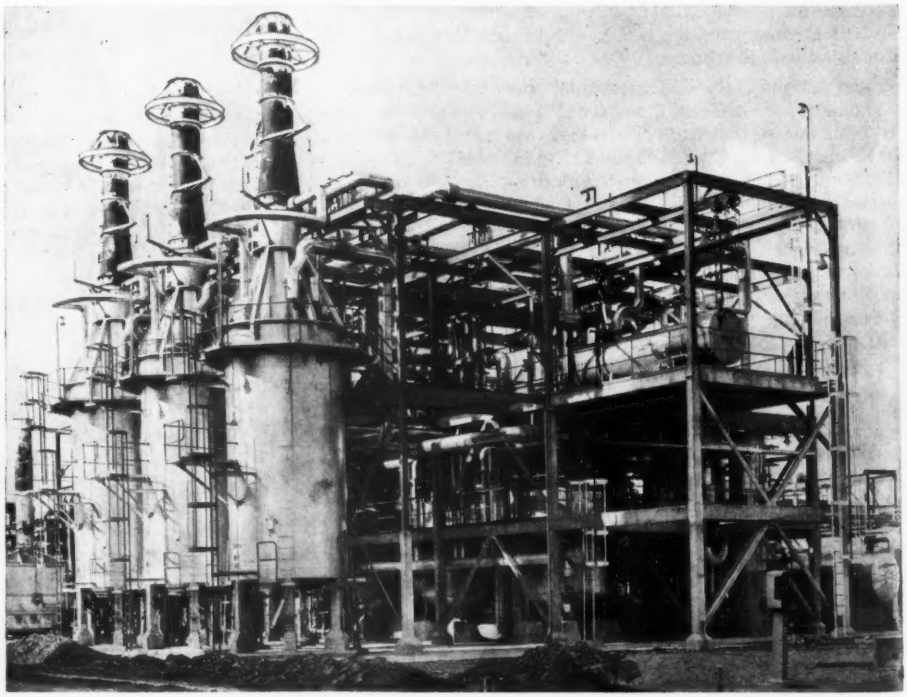
5. Styrene Modified Alkyd Resins. These resins make low-cost ingredients for air-drying enamels. Such enamels have a very high gloss and are extremely fast in drying.

6. Styrenated Oils. Styrene monomer can be used to modify and extend vegetable oils for the manufacture of paints, varnishes and enamels. Not only is an economy effected in the use of drying oil but the use of styrene imparts desirable properties: quick drying, excellent gloss and resistance to yellowing.

7. Ion Exchange Resins. Styrene polymer can be used to manufacture completely insoluable ion-exchange resins, which can increase the capacity of a water purification system up to ten times and may increase the rate of flow by as much as 50%. These resins can also be used as refining agents and catalysts in chemical processes, and for clarifying beet sugar and syrup.

8. Polyelectrolytes. Copolymers of styrene and unsaturated dibasic acids may be used for producing water-soluble polyelectrolytes. These, under suitable conditions, can act as protective colloids and as emulsifying, dispersing and film forming agents. They also have valuable flocculating properties.

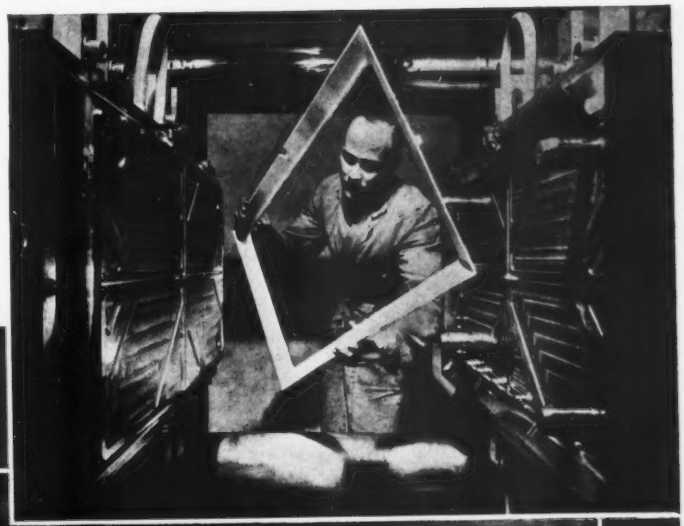
The significance of the new plant at Grangemouth is twofold; as a means of satisfying all of the U.K. demand for styrene monomer, it functions as a valuable dollar-saver. Additionally, much credit is due to Forth Chemicals Ltd., and its associated companies in bringing into production, in such a short space of time, a plant of immense complexity and ingenuity.

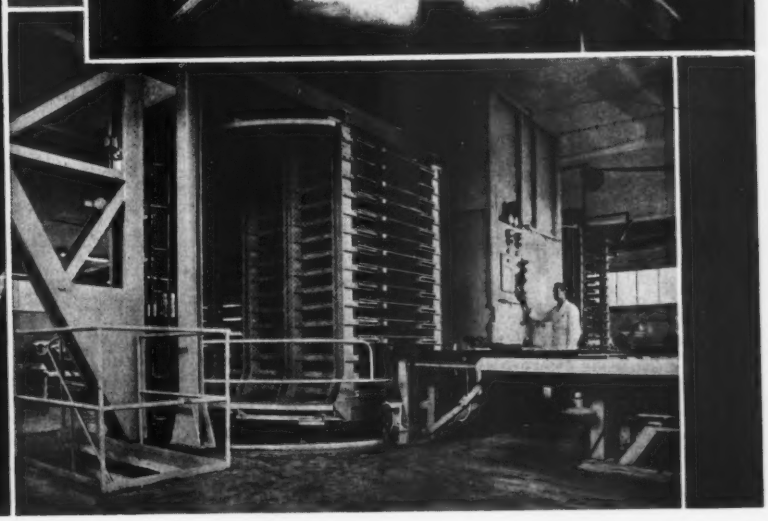


The new dehydrogenation unit, seen here from the south-east, showing the super-heaters which supply steam to the process. The dehydrogenation process, which is endothermic, is run at a temperature of about 630°C.

Plastics in Sweden

(Above) Examples of blown polythene bottles for pharmaceutical and toilet purposes. (Right) Injection moulded bathroom accessories. (Left) Foamed polyurethane used here for insulation. Manufactured by Bayer of Leverkusen. (Right) Polystyrene refrigerator trim moulded by Skanska Attikfabriken A.B. (Below, left) Vacuum formed bath, by Skanska. (Below, right) Decorative laminate manufacture in multiday-light press.





Britannia Replica in Polystyrene

In production for British Overseas Airways Corporation is a miniature version of the Britannia. Moulded and assembled by Hughes Brushes Ltd., the model calls for high quality standards. This article describes the manufacturing process

THE aircraft industry, it is acknowledged, insists on very high standards of accuracy in all manufacturing processes. What happens when you scale down an aircraft to $\frac{1}{72}$ of full size, and injection mould it in polystyrene? Meeting, of course, the critical standards of the British Overseas Airways Corporation, for whom the replicas are being made.

The answer is to be found at the new factory on the Slough Trading Estate, of Hughes Brushes, Ltd. Now in production is a scale model of the Britannia, designed for display purposes by the British Overseas Airways Corporation, and subsequently to be sold as a constructional kit to model-makers.

Hughes Brushes, an affiliate of Johnson & Johnson, are well equipped to deal with top-quality moulding, being one of the principal U.K. tooth brush manufacturers. As is well known, very high standards indeed are imposed in this industry, and the quality control necessary in any factory manufacturing such an essentially personal item as a toothbrush makes simple work of most other moulding procedures where accuracy and cleanliness are essential. The organization has been helped in the fact that the new factory, only recently constructed, has been planned as a moulding unit, with the important addition of space for assembly and other post-moulding operations.

The photographs which illustrate the article tell the story of manufacture most vividly. They cannot, however, directly record the behind-the-scenes work, especially the close co-operation between the moulder, B.O.A.C., and the toolmaker (Plastools, Ltd.), all of whom spent many hours of discussion before the tools were put in hand, and the production programme planned. We see here the result of this planning, in this sequence of photographs, taken at the Slough factory.

Fig. 1 shows the tool for the top fuselage, which is moulded in high impact white polystyrene. The feature of this tool is the deep core to save weight in the rudder fin. A 22-oz. Impco machine is used for this moulding. The bottom half of the fuselage is moulded by the tool shown in Fig. 2. This is of special interest because of the side cores moving with dowel pins which produce the recessed roots for the main wing structure. The tail plane is an integral part of the fuselage, and the moulding is made in an 8-oz. Reed Prentice.

In Fig. 3 is shown the tool for the wings; each wing is made in two halves, incorporating the turbo-prop engines, and the spinners are also moulded in the same tool. A 22-oz. Impco is employed, and the tool weighs 13½ cwt.

Fig. 4 shows perhaps the most interesting mould from the toolmakers point of view. In order to get a straight-line ejection on the neck of the moulding (which is the stand for the aircraft), the base has been turned to an angle of 45° to the horizontal; the streamlined shape of the base permits normal mould-opening. Incorporated in this tool is a separate insert to mould the top of the stand, which has two brass insert pins.

Assembly

Some idea of the precision approach to the assembly of these models is conveyed by Fig. 5, which offers a general view of the line. The care that is taken at this stage of manufacture is essential to a high quality product. The operator seen in Fig. 6 is assisted by a simple wooden jig clamping the two halves of the fuselage at three points. The line-up of the two halves must be exact. Similarly in Fig. 7, jigs hold the port and starboard wings firmly in position in the roots recessed into the fuselage. In Fig. 8, the underside of the aircraft is sprayed silver, the upper half being masked by another wooden jig. Following application of transfers, the model is finally inspected and touched-up where necessary (Fig. 9).

The final operation (Fig. 10), after silk-screen printing the legend on the base, is the weighting of the base, by filling it with a special mixture which is afterwards covered with a flock-sprayed paper. After another inspection, the models are ready for packaging and dispatch.

Sample models have, of course, been thoroughly examined by the British Overseas Airways Corporation, and have met the very high standards required by that organization. Hughes Brushes must naturally take most of the credit for this, for the moulding and assembly is most carefully done. The material used has also played its part; high impact polystyrene, manufactured by Styrene Products, Ltd., has fulfilled itself excellently in holding the close tolerances called for.

The models will shortly be distributed by B.O.A.C. to travel agencies all over the world, and the graceful lines of the Britannia will be faithfully mirrored in miniature form for the benefit of the many passengers who will fly in the full-scale counterpart.

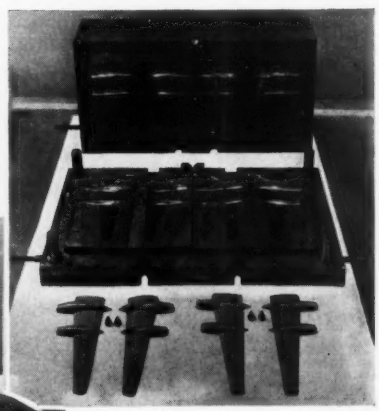


Fig. 1 (Far Left). Tool for top half of Fuselage.

Fig. 2 (Centre). Tool for bottom half of Fuselage.

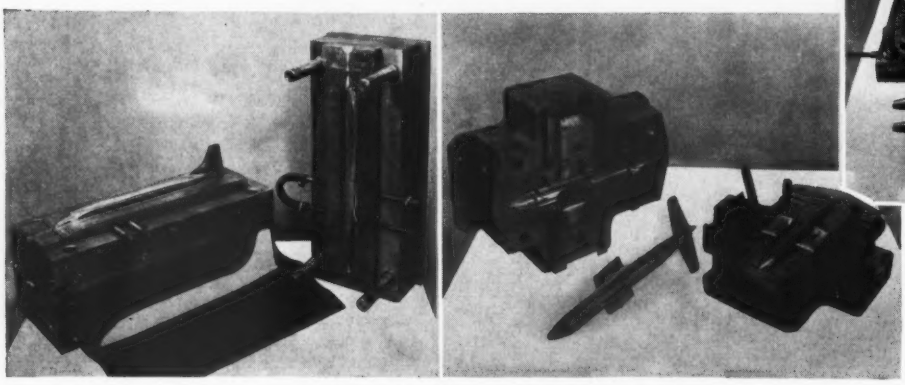


Fig. 3 (Above). Tool for wing sections, including the spinners.

Fig. 4 (Below). Tool for moulding base.

Fig. 5 (Above). Production line.

Fig. 6 (Below). Cementing fuselage.

Fig. 7 (Right). Fitting wing sections into the fuselage.

Fig. 9 (Below). Inspection and touching-up.

Fig. 8 (Below). Spraying booth. Underside of aircraft is being sprayed silver.

Fig. 10 (Below). The base is filled to weight it, and the model is mounted.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Glass Fibre Boats

SIR,—In view of the conflicting comments that appear from time to time on glass fibre boats we feel you may be interested in the following report, which is the first official one we have seen on these craft in government service.

Permission to publicize this report—Official Paper No. MATM 3158/56 was granted in a letter from the Secretary of the Admiralty dated 6th November. It is in respect of two of our standard 9 ft. glass fibre rowing/outboard dinghies supplied to H.M.S. *Protector* for use on her recent cruise to the Antarctic, and extracts are as follows:—

"It was realized that when visiting British bases in the Antarctic that landings would have to be made on open shores from the ship's boats. It was considered desirable to have small dinghies which could be used for the landing from the ship's boat. The fibre glass dinghies supplied have proved to be remarkably successful for this work. They are light and easy to handle and can, when required be carried on top of the canopy of the ship's motor boats. They are easily stowed, being slung up to the deckheads on a light line.

"Landings have been carried out in considerable ground swell on rocky shores. Such landings would have caused heavy damage to a wooden boat but the fibre glass dinghies only suffered scores in the hull. These were easily filled with resin from the repair kits supplied. An additional advantage of these dinghies which had not been foreseen is that they are ideal for use in landing through kelp (seaweed). Their very light weight and smooth glassy surface makes it possible to take them through the thickest kelp which would probably be impassable for a normal wooden dinghy. This has been invaluable.

"Both dinghies have been accidentally damaged, one by crushing and the other by a falling weight. The damage resulted in star shaped splits in the hull. These were cut out leaving holes approximately 10 and 12 sq. in. in area, and repairs carried out by the ship's staff, using the repair outfits, in less than half the time required had it been wooden construction . . . One repairer with double curvature was undertaken with the backing held in position by means of a Spanish rope windlass and small wooden wedges with excellent results."

W. & J. TOD LIMITED.

Ferrybridge,
Weymouth.

Moulds for Disposal

SIR,—We would like to inform you, that, we are converting our plastic production department to the manufacture of technical plastic parts, we therefore wish to dispose of various moulds. These are injection moulds for: children's building-blocks; children's chamber pots; children's fork, spoon and pusher; soap-dishes; and a compression mould for soap boxes.

If you know of anyone interested in any of the above moulds please let us know, and we will send samples to them of the articles in question.

NIENBURGER METALLWARENFABRIK
ADOLF THIES G.M.B.H.
1–19 Huttenstr.,
20a Nienburg/Weser.

Plastics in Russia

British Team Report on Exploratory Visit

DURING the period October 12–31, three members of the plastics industry visited the U.S.S.R. to study the Russian plastics industry. They were Mr. H. Bridge, of British Moulded Plastics Ltd., Mr. J. Lesser, of Crystalate Ltd., and Ebonestos Industries Ltd., and Mr. R. Sternberg, of Sterling Moulding Materials Ltd. The tour of Russian chemical plants and moulding shops was arranged by the Ministry of the Chemical Industry, which body controls the plastics industry. We publish here extracts from a report made by the three British visitors.

Organization of the Industry

U.S.S.R. production of raw materials is channelled into two forms of fabricator: (1) "Captive" plants, such as telephone, building and electrical engineering factories, where moulding is carried out as an ancillary process. (2) Compression and injection moulding factories, operated in a similar manner to our trade moulders. Two-thirds of raw materials are directed to category 1, the remainder being absorbed by category 2. Nine plants were visited, located in the Moscow and Leningrad areas, all coming within the scope of category 2, although some were also functioning as raw material manufacturers.

A typical factory was the Karbolit plant, 60 miles from Moscow, employing 3,500 people. Urea and phenolic resins and moulding powders are produced, linked with moulding shops of considerable dimensions. In compression moulding, 300 presses are in use ranging in capacity from 25–2,000 tons. 25 injection machines are installed with capacities of 2 to 32 oz. 24,000 tons of moulding powder are produced annually, 90% being phenolic. Amongst the items moulded refrigerator door liners, moulded in phenolic impregnated laminated paper, and toilet seats in cellulose acetate. The tool room alone employed 200 people.

Research

Situated in Leningrad is the Institute for High Polymers, engaged in the research and development of plastics raw materials, and covering some 12 acres. Here facilities exist for analyis, testing, applications evaluation, and pilot plant production. P.T.F.E. is the subject of one current research programme.

Conclusions

The visitors conclude this report with a number of observations made as a result of what they saw and after discussion with Russian officials. Some of these are given below:—

"A feature that was very pronounced is the proportion of female labour employed on the work carried out in the factories which the party inspected. Without exception all press operators were female. In nearly all departments, both chemical and moulding, it was exceptional to see men employed on work which in this country is invariably carried out by men. Even in one tool-making department some women were employed.

"All the moulding plants visited were working five-and-a-half days per week on a three-shift system. The chemical plants on continuous processes were working seven days per week.

"The conditions in the moulding shops of the factories from the safety point of view, would not comply with the Factories Act and conditions obtaining in this country. Of the hundreds of hydraulic presses seen none was guarded. It would appear that due to the continuous expansion programme of this industry in the U.S.S.R. the inevitable problem of adequate factory space was being created. The first class canteens provided for the workers were noteworthy, and the factory medical services provided were on a high level.

"In all the moulding shops and departments engaged on work of a manual nature, the workers were working very intelligently and speedily. Individual incentive is encouraged by a form of piece-work payment. Factory collective bonus schemes are also in operation.

"Orders for mouldings in nearly every case are, by our standards, very considerable, and the 'runs' from the same tools in many cases continue for very long periods without a break.

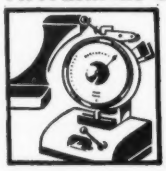
"We would repeat, as already mentioned in this report, that in general the mouldings we saw produced were of a nature less intricate than many of the types of articles moulded in this country, and our impression was that the emphasis was more on speed of production than quality of the finish."

In a meeting with the Deputy Minister of the Chemical Industry, the visitors asked if the U.S.S.R. was prepared, in addition to fostering the interchange of technical data, to consider the purchase of British plant, equipment, materials, and moulded articles. The answer was a direct affirmative.

The visitors conclude their report by stressing their belief that in Russia is a market for us of great potentiality, their needs for goods at the present time being comparable to ours at the end of World War II.

World's Industry Employs Plastics

MATERIALS and TESTING



The polymerization of vinylchloride is discussed generally, by G. Bier and H. Kraemer. In particular the possibilities of reduction and oxidation based on experimental work; the probable presence of double bonds in the polymer is noted. Also other chemical groupings in the polymer due to traces of emulsifiers and catalysts may be present. Problems of branch chains are discussed; the degree of branching seems to depend on the polymerization method applied.
(*Kunststoffe*, 1956/Nov./498.)

Combination of plastic foils serves for improving the properties by mitigating the weaknesses of one material by the improved properties of another. At the same time certain critical properties should be present. In this way laminates are produced from paper aluminium foil, Cellophane or other plastic foils. In the same way different plastic foils can be combined.
(*Kunststoffe*, 1956/Nov./506.)

Dielectric properties of plastics.—B. H. Daimler makes an attempt to give a survey on the relationships between nuclear conditions in the material and dielectric measurements for determining the electric insulating properties; these can be used to determine the internal structure. The various conditions insulating materials have to fulfil in various fields are also noted.
(*Kunststoffe*, 1956/Nov./508.)

Granulated polyvinyl materials without plasticizer.—G. Wick and H. Koenig deal with the preparation of granules which have a low volume density and a correspondingly greater surface area and therefore being more suitable for extrusion and injection moulding than other p.v.c. types. Machinery necessary for this purpose is described. Recommendations for the various structural materials for screws, cylinders and parts of injection moulding machines are given.
(*Kunststoffe*, 1956/Nov./533.)

Degree of gelation of p.v.c. leathercloth.—F. Schimke has slightly modified the "ethyl acetate" method by Kling. Investigations show that it is rapid and reliable and gives consistent results.
(*Kunststoffe*, 1956/Nov./537.)

After-treatment of polyamide mouldings.—Whilst in previous instalment the immersion in oil and boiling water was dealt with, the present article deals with new methods of improving surface finish and the formation of the transparent edges in a crystalline structure by blowing hot gases against them. The surface hardness of the treated surface layer is improved; however no actual data are given.
(*Kunststoffe*, 1956/Nov./540.)

Stress-optical freezing tests on cast resins.—Stress optical methods cannot only explain the cause of damage but follow the course of stresses on structural parts by models. In the three dimensional method a model of the structural part is "frozen-in" in a furnace under a given load. Investigations have shown that the course of stresses deviates only by 3% from those determined on a static test sample.
(*VDI-Zeits*, 1956/Oct. 11/1683.)

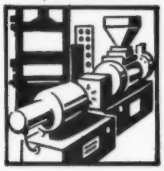
Photoelastic investigations on prestressed concrete.—In an extended Swiss investigation the selection of suitable materials for beams and prestressing elements as well as of adhesives has been studied in detail. The usual "hard" model materials with a modulus of elasticity of about 30,000 kg./sq. cm. were replaced by a rubber-elastic model material Vulkollan with a Young's modulus of about 40 kg./sq. cm. which was used for the prestressing elements.
(*Schweizer Archiv*, 1956/May/150.)

Representancy of dielectric properties.—W. M. H. Schulze discusses possible influential factors on the representancy and repeatability of dielectric properties of electrical insulation in their dependency from various physical and chemical factors.
(*Schweizer Archiv*, 1956/May/137.)

Gloss and elasticity measurements on lacquers.—H. R. Engelmann reports on gloss and elasticity measurements on nitro and plastic resin lacquers during a weather exposure of one year. Eighteen different coatings were investigated after 3, 6 and 12 months' exposure; the results are given in the form of graphs.
(*Schweizer Archiv.*, 1956/June/183.)

Glass-fibre reinforced plastics.—In a serial publication on the Chemistry, Physics and Technology of Plastics, H. Hagen contributes a volume of 519 pages on glass-fibre reinforced plastics, dealing with the raw materials, properties of the finished product, production methods and testing. A survey of the hitherto developed applications is also given.
(*Springer Verlag, Berlin*, Oct. 1956.)

PROCESSES : MACHINERY



Operating conditions for injection moulding of thermoplastics.—In this account, Dr. Werner Eulitz presents a mathematical treatment of injection moulding practice for thermoplastics with particular attention to the relationship between surface area and heat transfer and heat loss. The relationship between design and cooling characteristics is considered and the article includes a nomogram and a table showing the relationship between cooling time and surface area for injection mouldings of medium wall thickness in a number of plastics.
(*Der Plastverarbeiter*, 1956/Oct./377.)

Protecting metals with plastics.—G. Schulz investigates the different methods of lacquering and coating with plastics and finds that they are actually not competitive but rather supplementary methods. For lacquering a solvent or dispersing agent is essential, whilst in coating processes the plastic can be applied as a powder, paste, foil or plate.
(*Schweizer Archiv.*, 1956/June/178.)

Sawing of plastics.—With the assistance of 16 American firms R. A. Wason has compiled a guide on the sawing of plastics, indicating that high speed steel, sintered carbide and metalbonded diamond tools can be used, depending on the length of the production run. He goes systematically through the various, in particular modern types of plastics, and indicates which type of sawing blades are most suitable. When in doubt it is recommended to prepare an initial set-up as for sawing copper or brass.
(*Tool Engineer*, 1956/Nov./111.)

INDUSTRIAL APPLICATIONS

Plastic tooling for prototype cars has a number of advantages and brings great savings. Plastic tools are favoured by tool and die shops in the automobile industry owing to the simple equipment required. Materials can be reclaimed; quick and inexpensive testing and revision of design.
(*Automotive Industries*, 1956/Oct. 15/62.)

Instrument panels and fans of plastics are now, after three years' extensive testing, standard equipment with Citroen, Paris. The fan is moulded in nylon giving great strength. The same material is used for the upper part of the instrument panel for its resistance to infra-red rays used in drying paints. The plastic fan weighing only 300 grammes has been tested at speeds up to 12,000 r.p.m.
(*Automotive Industries*, 1956/Oct. 15/102.)

A plastic strip feeder supplies automatically laminated plastic and fibre strip stock into any blanking press at controlled temperatures up to 300° F. A single loading of the magazine can produce up to a day's run. The strip stock rests on a special feed belt synchronised with the press through a crank arm to an indexing roll feed.
(*Automotive Industries*, 1956/Oct. 15/146.)

MISCELLANEOUS USES

Plastic tubes for ice-free seaways. — Tests have been made in Sweden in the harbour of Vaesteras with Neoprene tubes of 330 m. length. Fine holes were provided in distances varying from 10 to 5 m. These tubes were fed with compressed air from a compressor of a capacity of 450 litre/min. The tubes were laid on the harbour bottom at a depth of 15 m. When compressed air was supplied surface ice of a thickness of 0.60 m. began to melt after 20 hours. After two weeks operation a gap of 10 to 13 m. width was kept open. It is now intended to keep an open seaway between Vaesteras and Soedertaelje, having a distance of 100 km.
(*Technische Rundschau* (*Berne*), 1956/Oct. 26/37.)

Plating of Thermosetting Mouldings

Details of a recently developed plating process which can be used successfully on thermosetting mouldings

THE coating of plastics mouldings with a metallic film has, within the last few years, developed considerably. From time to time we have published photographs of various articles for the toy and fancy goods markets, using polystyrene and cellulose acetate as the basic material, and metallized by high vacuum technique. In addition to these markets three-dimensional acrylic badges coated with a metal film, have been in increasing demand for use on refrigerators, cars and other articles. We are now pleased to report on a further development in this field with the successful electro-plating of thermoset mouldings.

The process has been developed by Metaltreat, Ltd., 359 Canal Road, Bradford, 2, Yorks., who have for many years been well-known as electro-platers and galvanizers of metal components. They have granted rights to Metachemical Processes, Ltd., of Crawley, Sussex, for the South of England, and are working in co-operation with Industrial Mouldings (Warwick), Ltd., of Emscote, Warwick. The latter company specialize in moulding components for subsequent electro-plating.

The process is suitable for most thermosetting plastics mouldings and the best results have been obtained with the use of phenolic materials, although urea mouldings, Diakon and polystyrene, are being satisfactorily processed. Owing to the heat present during stages of the process certain thermoplastic materials are not satisfactory for this type of deposition. Attention should be given to the design of a moulding which is to be electro-plated particularly in cases where hard polishing or selective deposition is to be carried out. Small radii and deep recesses which present considerable difficulty for plating or polishing are undesirable and can often be avoided by intelligent design and consultation before production.

Processing Technique

It is essential in the production of long-lasting plated mouldings that the initial silvering should adhere to the base material under all conditions. Much of the failure of previous processes has been due to this lack of adhesion resulting in the metal envelope parting company from the moulding.

The surfaces of the mouldings to be plated are first of all roughened or etched either by mechanical or chemical means before undergoing a precise cleaning cycle. They are then treated by immersion in a specially prepared sensitizer which makes them receptive to the chemical silvering process which follows and also ensures the adhesion of the film to the moulding. It is reported that the adhesion is so good that a silvered moulding can be polished without destroying the coating. However, for mouldings requiring a polished finish it is recommended that a .003 in. to .004 in. deposit of copper is given by means of a normal electro-plating process in an acid copper bath which contains special additives. These can then be polished or sateened with only slight danger of polishing through to the plastic. Care should be taken that excess heat is not generated during the polishing. After polishing the mouldings can be treated as if they were metal and may be plated in nickel, chromium, brass, silver, gold or whatever finish is required.

Advantages of the Process

The cost of electro-plating on plastics is approximately 25%–40% more than electro-plating on zinc-base die-castings or brass but in certain cases this apparent extra cost is more than balanced by the economy afforded in using a plastic moulding in place of, for example, brass. The properties of the plastic, such as its insulating properties, and its lightness, and its inertness, provide several advantages over comparative metal products. Of particular note is its inertness which means that corrosion cannot be set up as it can be in the case of zinc-base die-castings.

The plating also enhances the plastic and it is reported that chromium-plating can increase the strength of the basic material by as much as 80%. In addition it provides the moulding with a hard metallic surface of extreme durability. In all probability therefore the finished product will withstand rougher treatment than its die-cast counterpart.

Colour Matching Densitometer

Some notes on the transmission and reflection densitometers manufactured by the Baldwin Instrument Co. Ltd., of Dartford, Kent and their use in the plastics industry

WITH the growing application of instrumentation in the plastics industry, the procedure of visual colour matching is giving way to colour measurement by means of densitometers. This enables a sample to be compared with a standard to a higher degree of accuracy and, as the human element is not involved, with greater reliability. For fading tests, instead of merely observing that some fading has occurred, the actual degree of fade can be measured and correlated with the exposure given.

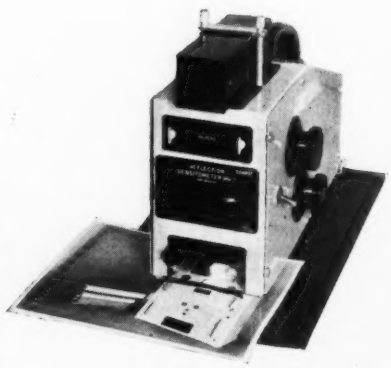
Two Baldwin Densitometers are available for density measurement and colour analysis of plastics. For transparent and translucent materials, the Transmission Densitometer is used whereas for opaque materials it is necessary to use the Reflection Densitometer.

Both instruments have built in facilities for using any types of colour filters. In colour measurement, the readings are normally in R.G.B. units.

In practice, the sample is illuminated by a beam of light produced by a tungsten-filament lamp which is supplied by a stabilized voltage source. The light passing through or reflecting from the sample is projected on to a vacuum photocell, via the appropriate colour filter. The output from the photocell is fed to a highly stabilized electronic amplifier, the output from which is indicated by a robust moving coil microammeter. The meter is fitted with specially shaped pole pieces which permit the density scale to be very much more linear than is usually the case. An alternative meter is available which is calibrated in % illumination. This is sometimes to be preferred in colour matching.

Compared with barrier layer type instruments which have no amplifier, these densitometers have a very high sensitivity enabling measurements up to density 6 to be made.

A new attachment to the Transmission Densitometer enables density and colour of liquids in continuous motion to be measured and, if required, recorded.

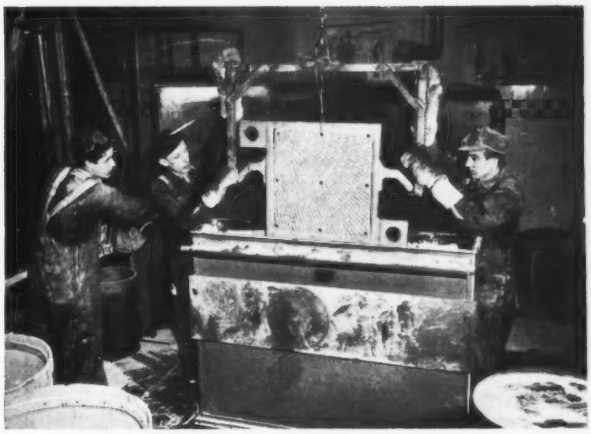


The Baldwin reflection densitometer.

Sinter Coating Equipment

Some details of new equipment for coating metal components with plastics materials. Finely divided polymer in a powder state is made to behave as a liquid so that the pre-heated metal parts can be dipped and a complete covering obtained. A flame spraying apparatus for larger objects is also described.

ONE of the obstacles in coating metal parts with polythene and nylon or other plastic powders has been the difficulty of obtaining a uniform thickness of coating on articles of complex shape. Straightforward dipping into powdered polymer results in a comparatively uniform exterior coating but an uneven and sometimes partial covering of the interior surfaces due to the inability of the powder to flow. To overcome this disadvantage the Fluidip process using the patent Griesheim Whirl Sinter units have been evolved and are now being sold in this country by Horwitch Smith & Co., Ltd., Pensnett, Brierley Hill, Staffs.



Dipping in the large Griesheim Whirl Sinter Unit.

The Whirl Sinter Process

This process involves the heating of the metal part either by flame or in an oven to a temperature of between 220° C. and 250° C. The part is then dipped into a tank containing the finely divided polymer powder which is being motivated by air pressure so that its behaviour is similar to that of a liquid. After 30–50 seconds immersion depending on the thickness of the coating required, the article is removed and if necessary baked in an oven at 120–140° C. for five to 10 minutes to complete the gelation of the polymer. Examples of coating thicknesses are, for a $\frac{3}{8}$ in. thick material heated to 250° C. with one immersion a $\frac{1}{32}$ in. coating; for a similar material heated to 200° C. with one immersion a $\frac{1}{64}$ in. coating. A second immersion can be given providing sufficient heat is retained after the first dip.

The Whirl Sinter Unit

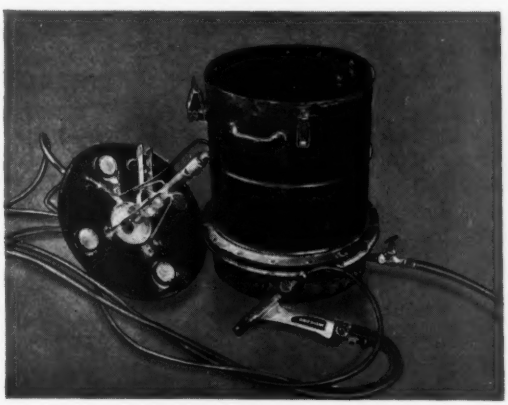
Various sizes of units are available but all work on the same principle. Air either from a compressed air line or from a built-in blower unit enters a compression chamber in the base of the unit. From here it filters through the porous ceramic cannister base at an even pressure throughout the area. The powder in the cannister is thus agitated, its volume increases up to 25% and it behaves as a mobile fluid exhibiting all the properties of a liquid of low viscosity.

The Sinter Spray Combined Apparatus

The small unit can be adapted to flame spraying by the use of a special powder fountain assembly as shown in our photograph. For operating by this technique nitrogen is fed through the base of the powder fountain and the powder to the flame gun. Dissolved acetylene concurrently fed to the flame gun provides the heat necessary and a control on the grip of the gun brings the powder supply line into action. Prior heating of the surface to be coated is necessary to ensure good adhesion of the coating. The quantity of powder fed to the gun is controlled by a valve on the nitrogen line and the pressure is controlled by another valve on the gun itself. The powder fountain can be used with any of the whirl Sinter units. The flame spraying apparatus is used when articles requiring coating are too big for immersion in the Whirl Sinter units and for applying a protective coating to objects *in situ*.

Advantages

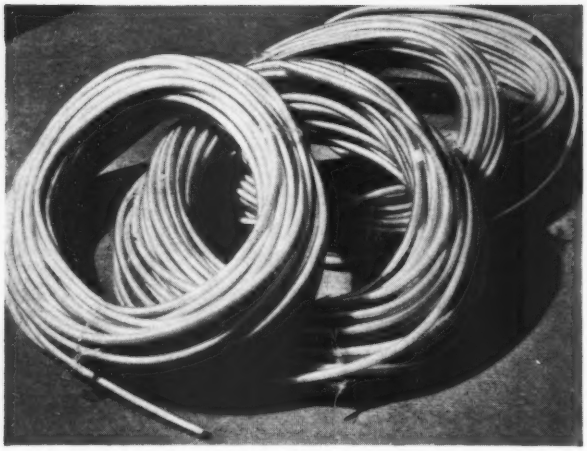
The advantages claimed for the whirl Sinter method are that there is no loss of plastic material during and after dipping (unless excessive air pressure is used); complete and uniform lining of complex shapes is possible; no deterioration in the polymer due to heat transfer from the dipped article; and, the equipment is relatively simple to maintain and use.

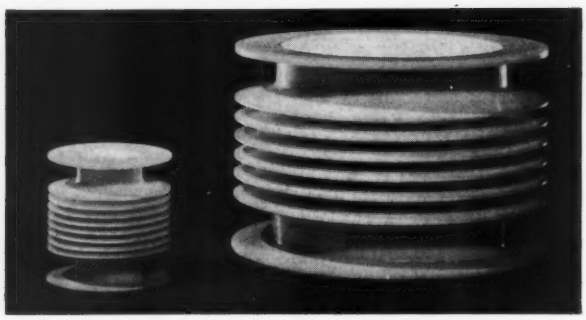


(Left) The smallest unit showing the flame spraying equipment for use on large areas.

(Right) A small self-contained unit showing the blower on the left.

New Productions





(Above) Expansion bellows made from p.t.f.e. by Crane Packing Limited.

(Left) Petrol hose with a reinforcing nylon braid extruded by Surco (Plastics) Ltd. in p.v.c.

Petrol Hose

This interesting hose which has been extruded by Surco (Plastics) Ltd., Kegworth, Notts., is in fact the product of two extrusion processes. The first process is an extrusion of Vybak VN 610 p.v.c. which is sleeved with nylon braid. The second process is a further extrusion of the same material over the braid. The final product is extremely strong has a good resistance to petroleum spirits and is impossible to kink. Vybak is supplied by Bakelite Ltd.

Chairs in Plastics

A new and unique range of chairs are being produced by Aidron Duckworth, 81 Stile Hall Gardens, London, W.4. These chairs are constructed in polyester/glass fibre material employing Cellobond resins manufactured by British Resin Products Ltd.

Each chair consists of a shell, which is moulded in one piece and mounted on stove-enamelled steel legs. The finish of the shell may be "natural," cellulose sprayed or upholstered with foam rubber and woven fabric.

The latest additions to the Duckworth range—the "Halo" and the "Bell"—are upholstered with foam rubber and Tibor fabric and illustrate some of the design features which are made possible by using this constructional material.

Corrosive-Resistant P.T.F.E. Flexible Bellows

The Engineering Division of Crane Packing Limited, Slough, Bucks, has developed a new and patented process for manufacturing p.t.f.e. bellows. The new process produces a stronger and more resilient bellows than normal methods of manufacture, and in addition it uses less of the raw material.

Because of the unique properties of the material, flexible bellows made from p.t.f.e. have many specialized applications in a number of industries, in particular those in which corrosive liquids and gases are handled.

Bellows of this type are suitable for such components as flexible connectors for pipes, sleeves and shaft glands which operate in contact with corrosive chemicals, solvents and lubricants. They have many uses in hydraulic power and control systems and in fluid pressure operated devices, such as meters and governors. Their high insulation resistance makes them suitable for insertion in pipe lines where it is necessary to break the electrical continuity or to prevent electrolysis between dissimilar metals on either side of a joint.

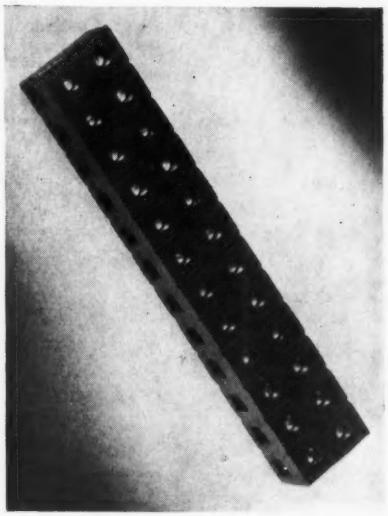
The bellows are at present offered in a range of bore sizes from $\frac{1}{8}$ in. to 6 in. and in corresponding nominal free lengths from $1\frac{1}{4}$ in. to 3 in. with wall thicknesses ranging from 0.020 in. to 0.040 in. Corresponding extensions are from 0.6 in. to 1.6 in.

Initial tests have shown that these bellows will withstand at least 1,000,000 oscillations between the minimum and maximum working lengths at normal temperatures, and at pressures around 30 p.s.i. Tests are continuing at higher temperatures and pressures.

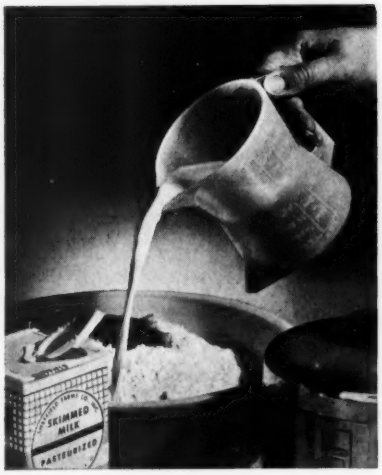
Flexible Terminal Strip

The 12-way 5/10 amp terminal strip shown in our photograph is injection moulded in black Vybak p.v.c. which besides making the strip resilient also provides the excellent electrical insulation properties which enable the moulding to withstand high working voltages. Moulding is being done for Precision Components (Barnet) Ltd., by Insulators Ltd., Leopold Road, Angel Road, London, N.18., who also designed and made the tool which is of considerable complexity.

(Left) Chair moulded in glass reinforced polyester by Aidron Duckworth.



(Right) Moulded p.v.c. terminal block by Insulators Ltd.



An American double measuring cup moulded in polythene.

Measuring Cup

A novel design in measuring cups which enables the cook to use the same measure for both wet and dry ingredients is now available to the American public. The cup is moulded in Tenite polythene by Westland Plastics Inc., 3317 East Pico Blvd., Los Angeles 23, California, and has a pouring lip and identical moulded-in graduations at each end.

Drop-Head Sidecar

An ingenious solution to the provision of a convertible open or closed sidecar has been developed by Protective Treatment Industries, Priory Mews, London, S.W.8, incorporating "Duraglas"/Polyester laminates made by Turner Brothers Asbestos Co. Ltd., Rochdale.

The moulded hardtop is readily removable and conforms in shape to the nose of the sidecar body, where it is stowed without inconvenience to the passenger. To permit this, the rear panel of the hood is also readily removed and stored separately in the sidecar, so that the passenger's legs extend inside the hood. The boot cover can be used as a back rest for an extra passenger.

One layer of 2 oz. glass mat and one layer of Turner's "Duraglas" woven rovings are used for the body's two main mouldings, the sidecar chassis cross-tube being bonded in internally in the lower moulding. Separate polyester/glass mouldings are used for the boot cover, mudguards and hardtop (with p.v.c. windows).

The sidecar's design has been registered, and the hardtop is the subject of a Patent Application.

Butt Plate

For over a century horn has been the traditional material manufacture of butt plates for sporting guns but today as in other applications, plastics are replacing it. Our photograph shows a butt plate which has been injection moulded in high impact polystyrene by Studio Plastic and Metal Components, Ltd., 93–95 New Town Row, Birmingham 6. The moulding is of high quality, which is to be expected considering its application, and must have presented some difficulty because of the thick sections called for. Double runners have been used to ensure the cavity is filled.

P.V.C.-Coated Fabric

I.C.I.'s Leathercloth Division is now manufacturing, by a completely new process, a p.v.c.-coated fabric which can "breathe." The new product, Vynair, is the first of its kind to be produced in Britain. Available in modern designs, it is suitable for the covering of loose foam-rubber cushions of three-piece suites, cushioned chairs or contemporary stools.

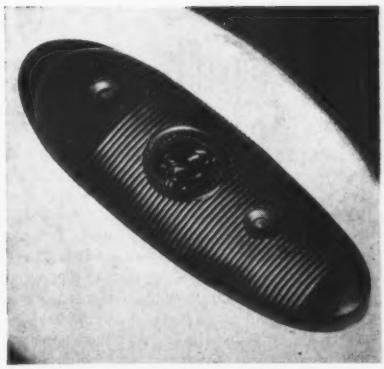
Vynair possesses the durable and stain-resistant qualities of Vynide, p.v.c.-coated fabric, and in addition offers the "breathing" properties which permit it to regain its shape without the use of eyelets in the material.

Metallized Fabric

Also produced by I.C.I. Leathercloth Division is Splendex, a metallized p.v.c.-coated fabric. The new product is an aluminium coated leathercloth which has an overall covering of Melinex (polyethylene terephthalate) which serves the dual purpose of providing an abrasion resistant surface and preventing the aluminium from tarnishing. Various embossed patterns and grades are available suitable for sewing or welding. Besides the obvious decorative uses to which it can be put, Splendex has been used as a surfacing fabric for heat resistant clothing. For this application a special grade, which did not have the Melinex coating, was used.

Knitting Needle Holder

Sets of four sock knitting pins are usually packaged and displayed bundled with a paper band. In conjunction with Messrs. Needle Industries Ltd., of Redditch who manufacture the well known brand of Milward Knitting Pins, Miller Manufacturing Co., Ltd., Malamold Works, Deal, Kent, have developed moulded polystyrene end caps, held together by a rubber band as shown in our photograph. These end caps serve both for displaying the goods and for after use by the user for retaining the pins in sets and the inserted disc makes the gauge size immediately obvious.

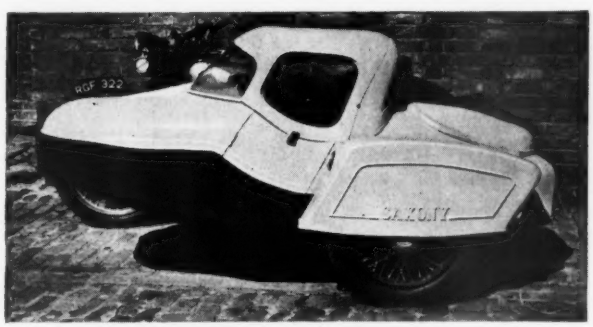


Sporting gun butt plate, moulded in high impact polystyrene.

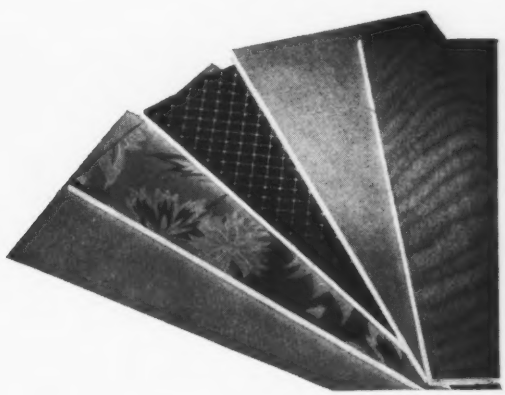
Polystyrene end caps for holding knitting pins.

Plastics Panelling

Plastics Marketing Co. Ltd., Buckhurst Avenue, Sevenoaks, Kent, have introduced an attractive wall panelling material. Known as Polypanol it consists of Vynide fabric supported p.v.c. sheet firmly cemented hardboard. An attractive range of colours and designs as well as various finishes are available in standard sizes. Panels having a laminated plastic back with a Vynide covering are also manufactured.



(Above) Glass reinforced polyester sidecar of unique design by which it can simply be converted to an open style.



(Right) Panelling made from hardboard to which Vynide has been cemented. Made by the Plastics Marketing Co. Ltd.

Plastics NEWS

Plant and Equipment, Materials Processes, Company News, Technical Literature, Exhibitions, Personal Notes, and Meetings

WET BELT GRINDER.—A new 9-in. wet belt grinder produced by Taylor Tools & Supplies, Ltd., of Vortex Works, Broadheath, Altrincham, has been designed to derive the utmost efficiency from the latest electro-coated, resin bonded abrasive belts.

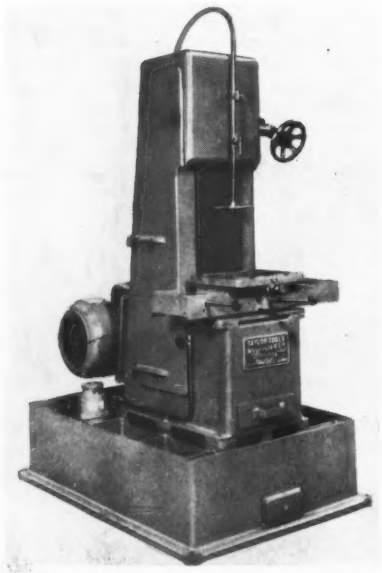
The illustration shows the hand-operated micrometer table which has anti-friction ways. The table is " Tee " slotted and can be traversed clear of the belt for work setting. The micrometer stop permits repetition sizing. Automatic work fixtures or a plain fixed table can be had in place of this table.

A feature of the design is that the abrasive belt pulleys, both driving and idler, are not " overhung " but supported on both sides in large ball and roller bearings, housed and protected by labyrinth seals.

The hardened and ground platen is mounted on a platen carrier which has screw adjustment by means of which the platen can easily be squared to the work table. A feature of this equipment is its simplicity in use.

General

Organic Red Pigment.—A new pigment known as Irgalite Red HGL has been produced by The Geigy Co., Ltd., Rhodes, Middleton, Manchester. This pigment has been specially developed for use in plastics and in particular p.v.c., where its non-migratory properties will be appreciated. The pigment has been reported as having exceptional fastness to light and heat and can be successfully incorporated in other plastic compounds.



The 9-in. wet belt grinder described in the first paragraph.

Automatic Extrusion Marking Machine.—Shown at the recent Paris Plastics Exhibition was an automatic marking machine for plastics extrusion. This machine, manufactured by Dubuit of Paris and being sold in Great Britain by Dubuit, Ltd., 8 Chase Road, Park Royal, London, N.W.10, utilizes a hot-die-stamping process in conjunction with coloured foils, thus avoiding the necessity of a drying period. Imprints can be made at any pre-set intervals and as the speed of the machine is governed by the linear speed of extrusion thus a variation in the latter does not cause variation in the interval between marks.

Anti-Static Polishing Cloth.—J. Goddard & Sons, Ltd., Nelson Street, Leicester, have developed an anti-static polishing cloth. The static charge within the moulding or fabrication can be dissipated by wiping with this cloth which in addition leaves an invisible film on the product, thus providing protection against any further accumulation.

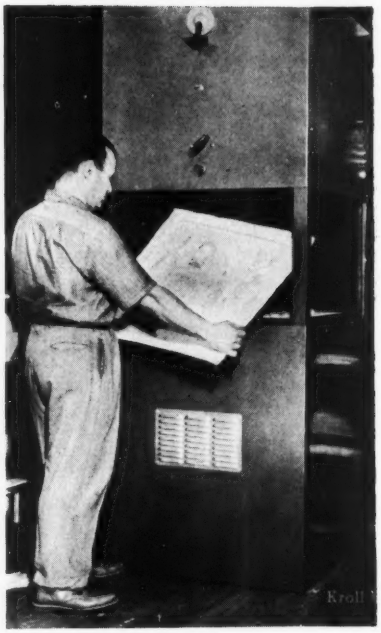
Christmas Greetings

The Editor and Staff extend Christmas Greetings and Good Wishes for the New Year to their readers at home and abroad.

New Siliconate Developed for Masonry.—Midland Silicones, Ltd., 19 Upper Brook Street, London, W.1, have announced that they have developed a new siliconate for making building materials water-repellent. The new product, Experimental Siliconate D 3033, is a highly alkaline solution of sodium methyl siliconate and when applied to masonry lines the surface pores with a thin water-repellent film which does not change the appearance or breathing characteristics of the masonry.

Experimental Siliconate D 3033 is at present recommended for evaluation as a treatment for brickwork and concrete where the use of organic solvent solutions of silicone resins is not acceptable.

Post-Graduate Awards.—By arrangement with the Ministry of Education and the Treasury, the Department of Scientific and Industrial Research has assumed responsibility for making practically all fresh awards from public funds to post-graduate students in science and technology. The awards will be made for training in research as in the past, but in addition will also be made for courses of advanced instruction. This new arrangement does not alter in any way the fields of science and technology covered by the D.S.I.R.

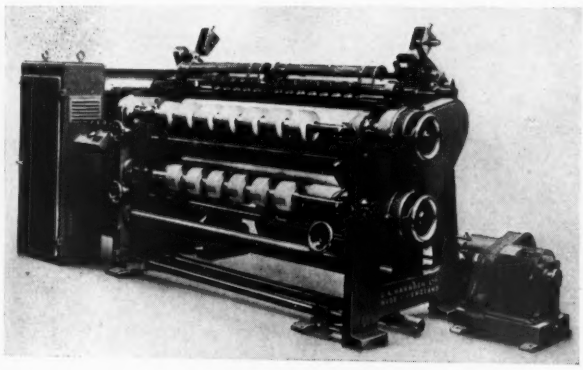


A new and inexpensive vacuum forming machine being manufactured by Kroll Equipment Co. of Chicago.

Fatty Alcohols.—Cyclo Chemicals Ltd., Manfield House, 376 Strand, London, W.C.2, are introducing four new high-molecular weight fatty alcohols. These are: **Ricinoleyl Alcohol** (Adol 40)—a viscous, clear, almost odourless liquid containing two hydroxyl groups and one double bond, iodine value 85–95, hydroxyl value 300–370. **Linoleyl Alcohol** (Unadol 40)—a light yellow to white oily liquid with one hydroxyl group and two double bonds, iodine value 115–135, hydroxyl value 205–215. **Linolenyl Alcohol** (Unadol 90)—a light yellow to white oily liquid with one hydroxyl group and three double bonds, iodine value 165–185, hydroxyl value 205–215. **12-Hydroxy-Stearyl Alcohol** (Adol 84)—a white crystalline saturated fatty alcohol with 2 hydroxyl groups and a melting point of about 69°C, hydroxyl value 340–365.

New Moistureproof Film.—British Cellophane Limited, 12–13 Conduit St., London, W.1, have released details of a new transparent, moistureproof type of " Cellophane " cellulose film, known by the code letters MXXT. It is stressed that, at present, supplies are strictly limited, although plans to increase capacity to meet the growing demand are in hand.

MXXT film is reported as being exceptionally resistant to the passage of water vapour and provides a more effective moisture barrier than any other film of comparable thickness at present available in the world. Other properties of the new film are its dimensional stability (under normal changes in humidity it will not shrink or wrinkle) and a surface brilliance which, combined with freedom from wrinkling, make it a particularly attractive packing medium. MXXT is not adversely affected by creasing, printing or heat-sealing, and is highly resistant to fats, oils, greases and to the passage of gases and odours. The base film is of



The B8X/H slitting and re-winding machine being made by C. A. Harnden Ltd.

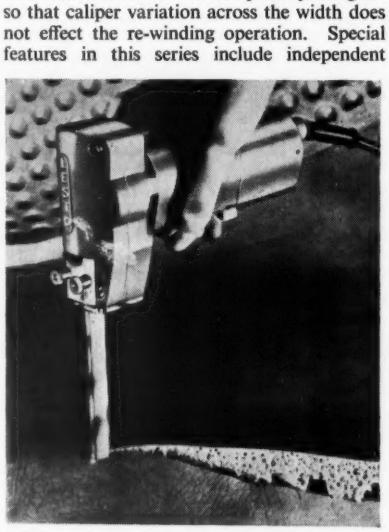
regenerated cellulose plus a new type of moistureproof, heat-sealable coating.

Electric Cutting Tool.—Trend Industrial Equipment Ltd., 5 The Ridgeway, Stanmore, Middlesex, announce that a new electric portable cutting tool is now available in this country.

This is manufactured by Scintilla Limited Soleure, and is known in Switzerland, as the Lesto Electric Foam Rubber Cutter. The cutter is an electric tool, designed mainly to overcome the difficulty of cutting and shaping spongy materials such as foam rubber, foam plastic, rubberized hair and similar materials. A pair of fast reciprocating saw blades, both travelling on the same plane but in opposite directions are held in place by a slotted guide which secures the two blades flat against each other at the right pressure. The multi-scissor movement, as it can be called, is very fast indeed, resulting in a clean and even cut.

A 10 in. thickness of foam rubber can be negotiated if a suitable set of blades are inserted or ten layers clamped together can be cut at one time.

Slitting and Re-winding Machines.—A new series of machines suitable for use in the slitting and re-winding of plastics, paper and foils has been introduced by C. A. Harnden Ltd., Dowson Road Engineering Works, Hyde, Cheshire. These augment their present range of machines and have been specially designed so that caliper variation across the width does not effect the re-winding operation. Special features in this series include independent winding coils and electronically controlled variable speed drive to the re-winding shafts working in conjunction with an automatic tension brake.



The electric cutter being distributed by Trend Industrial Equipment Ltd.

" Hinges for Plastic Containers."—We very much regret that in redrawing sketches submitted by the author of the above paper, (*Plastics*, November, pages 302–303), the identifying numbers were transposed. The numbers shown on the drawings should be changed as follows: 1=8, 2=9, 3=10, 4=11, 5=12, 6=13, 7=14, 8=15, 9=16, 10=17, 11=18, 12=19, 13=1, 14=2, 15=3, 16=4, 17=5, 18=6, 19=7. In addition drawing number 17 (which is in fact drawing 5) should have a pair of connecting straps between the body and the lid.

Plastics Piping.—In our November issue, under the heading " Plastics Piping " we stated that the new I.C.I. Alkalite process of jointing was the only all-polythene method. We should point out that in our December, 1955, issue we published a note on the Plastronga fittings, incorporating threaded couplings and conically shaped flanges, manufactured by The Yorkshire Copper Works Ltd., Leeds, also an all-polythene system.

Literature

Unpublished Reports.—PB.118100 " Treatment of Viscosity Data on Polymer Solutions I. Intrinsic Viscosity and Slope Constants."—Existing equations and conventional procedures for the graphical determination of intrinsic velocity and slope constants are analyzed. It is shown that slope constants obtained by these methods contain a systematic error which varies with intrinsic velocity. Several new equations and procedures are proposed.

PB.111857 " Dielectric Dispersion Behaviour of Selected Natural Polymers."—The results are given of experiments on the variation of dielectric constant, and loss factor with temperature and frequency for the esters of corn amylose and amylopectin, and cellulose, using as a basis, the Clausius Mosotti theory of anomalous dispersion.

PB.115565 and 115666 " Development of Silicone or Fluorocarbon Interlayer Materials for Laminated Glass or Laminated Plastic."—Quantitative results of various polysiloxane interlayer materials tested are given in the first report. Four show promise, two of these have good thermal stability at 250° C. after 48 hours. In the second report data are given on optical and shatter resistant properties of three of these and on work on the effect of interlayer thickness.

Copies of these reports can be obtained on application, from The Technical Information and Documents Unit, Cunard Building, 15 Regent Street, London, S.W.1.

New British Standards.—B.S.1322 : 1956 is a revised standard dealing with aminoplastic moulding materials only. The standard affects three types of aminoplastic moulding materials: Type A: General. This includes cellulose-filled (former type UX) and wood-filled urea-formaldehyde (former type U) materials. Type M: with improved resistance to hot water. This normally is a cellulose-filled melamine-formaldehyde material. Type H: with improved electrical properties at high temperature. This includes moulding materials (usually melamine-formaldehyde) with mineral fillers such as asbestos and glass-fibre. Requirements are specified for 12 properties and methods of test are given for each of them.

B.S.903 pt. C1 and C2 : 1956 deals with methods of testing vulcanized rubber.

Copies of the standards are obtainable from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

Polyvinyl Acetate Emulsions are the subject of two technical bulletins issued by British Oxygen Chemicals, Ltd., Vigo Lane, Chester-le-Street, Co. Durham. One deals exclusively with its application in emulsion paints and the other with its use in the textile, paper and other industries.

Corrosion Prevention.—A booklet published by Silvertown Rubber Co., Ltd., of Herga House, Vincent Square, London, S.W.1, shows how corrosion prevention by means of rubber and ebonite lining can be operated.

Technical Service Bulletins.—Two bulletins have been issued by Monsanto Plastics Ltd. The first one deals with anti-static finishes for Polystyrene and the second with the lacquering of polystyrene mouldings. Both bulletins contain much useful information and can be obtained from Monsanto House, 10–18 Victoria Street, London, S.W.1.

Polyhydric Alcohol Esters.—A new, 1956 issue of the catalogue " Esters by Glyco " has just been published, by Glyco Products Co. Inc., Empire State Building, New York 1, N.Y.

The fatty acid esters of glycerol, glycols and polyethylene glycols are described in this 24-page catalogue which includes tables of the physical and chemical properties of these non-ionic surface active agents.

Industrial Adhesives.—A catalogue of their range of industrial adhesives is available from Surridge's Patents, Ltd., New Works, Croydon Road, Elmers End, Beckenham, Kent. This gives details of Titebond a new general adhesive.

I.C.I. Publications.—In the last few months several publications on the handling, fabrication and properties of I.C.I. materials have been issued. These include: Crinothene for lampshades, an instruction manual for the covering of lampshades; Corrugated Perspex for flat roof lighting, a description of the use of this material and its fitting; Plastics for Aircraft, a survey of the properties of different materials; Diakon, a full description of its properties and moulding techniques; Alkalite Polythene Pipe Fittings, a new fitting welded into place by means of resistance wires; Darvic P.V.C. Sheet, a description of its properties

and fabricating qualities; Mouldrite Thermosetting Moulding Powders, dealing with the phenolic and urea type of moulding material. Copies of these publications can be obtained from the Plastics Division, Black Fan Road, Welwyn Garden City, Herts.

Directory Supplement.—The Association of British Chemical Manufacturers has published a supplement to the 1955 edition of the Association's Directory. Copies can be obtained from the Association at Cecil Chambers, 86 Strand, London, W.C.2.

Injection Moulding Machines.—Details of the SH1 1-oz. machine, the 1044 Autoplas with multi-screw pre-plasticizer unit and the A.P. 2088 fitted with single stage multi-screw pre-plasticizer unit, injection moulding machines have been published in leaflets issued by R. H. Windsor Ltd., Leatherhead Road, Chessington, Surrey.

Revised Test Procedure.—Two revised pages for their Methods of Test for Coated Fabrics Handbook have been issued by The Leathercloth and Coated Fabrics Manufacturers' Association, 57 King Street, Manchester 2.

Vacuum Forming Sheet.—Saro Laminated Wood Products, Ltd., Whippingham, East Cowes, Isle of Wight, have published a booklet on the different methods of vacuum forming their Saroy high impact polystyrene sheet. Saro do not do any custom vacuum forming themselves.

Chemical Engineering in the United States.—Published by H.M.S.O. for D.S.I.R., price 2s., by post 2s. 2d., and copies can be obtained from Charles House, 5–11 Regent Street, London, S.W.1.

The report is one of a series of surveys on scientific and technical subjects which is being made under the guidance of the scientific attache in Washington. The present publication was prepared by Dr. P. H. Calderbank, a member of the staff of the Chemical Research Laboratory and is based on visits to educational centres and industrial establishments and on conversations with many representatives of those concerned with the selection, training and employment of chemical engineers in the U.S.A.

The publication deals with the development of chemical engineering, the progress of which in the United States has been spectacular, the present position in chemical engineering education and the way in which chemical engineering practice has developed.

Of particular interest are some of the methods of teaching chemical engineering science. Under one scheme—the "practice school" method—groups of university students work in industrial plant with their instructor on special problems of interest to the host company. Another method of training, "plant design," requires students to co-operate with each other and their instructor in designing full scale chemical plant for various purposes. There are also "sandwich courses" similar to those in this country, in which students divide their time between the university or technical college and industrial undertakings.

A recent development is an increasing emphasis on teaching students fundamental principles of "Engineering Science." These courses contain no technology but concentrate on physics, chemistry and mathematics. It is hoped in this way to train graduates who will fit into any of the established branches of engineering. Specialization is relegated to a later stage of the educational system and the student acquires his training as a specialist either by post-graduate research and advanced study or by gaining practical experience of specialized subjects in industry itself.

A section of the United Ebonite and Lorival Ltd. travelling exhibition.

Company News

The Du Pont Co. (United Kingdom), Ltd., announce that it has taken option on a 381-acre tract near Londonderry, Northern Ireland, as the prospective site for a neoprene synthetic rubber plant.

The company state that start of plant construction in early 1957 was contemplated, assuming successful completion of engineering and economic studies now under way.

The establishment of the Du Pont Co. (United Kingdom), Ltd., was announced last April. It has been providing herbicides of British manufacture for the British market.

Reliance Trading Co. will be moving to larger premises at 75 Fairfax Road, London, N.W.6, telephone number Kilburn 0581, on December 27.

Davis and Timmins, Ltd., have opened a new stock depot at 12/14 City Road, Bristol, under the management of Mr. A. C. Jones. The telephone number is Bristol 26661.

William Jessop and Sons, Ltd., of Sheffield, 9, have entered into an agreement with the Heppenstall Company of Pittsburgh, U.S.A., for the manufacture and distribution of Hardtem die blocks in the U.K.

Durable Plastics, Ltd., have moved to their new factory at Woodbridge Industrial Estate, By-Pass, Guildford, Surrey. Telephone number Guildford 5228/9.

I.C.I. Plastics Division.—As the result of an agreement concluded between the Plastics Division of Imperial Chemical Industries, Ltd., and the M. W. Kellogg Co. of New Jersey, U.S.A., the former will distribute in the U.K. a wide range of Kel F. fluorocarbon polymers. These polymers represent a series of specialized products with a diversified range of industrial uses.

John Dale, Ltd.—The rights for the manufacture in Great Britain, Canada, and Switzerland of plastic collapsible tubes patented and held by Flexipac, Ltd., have been acquired by John Dale, Ltd., New Southgate, London, N.11.

Food Machinery and Chemical Corporation have formed an Organic Chemicals Division to take over the Corporation interests and activities in organic chemicals and plastics.

Film Show.—Saro Laminated Wood Products, Ltd., have recently produced a 16 mm. colour film showing the extrusion of their Saroy high impact polystyrene. The film runs for approximately 18 minutes and shows in addition to the extrusion process, methods of vacuum forming. Copies are available on loan by arrangement with Mrs. Glasspell, Saro Laminated Wood Products, Ltd., East Cowes, Isle of Wight.

The Gauge and Tool Makers' Association presented a cheque for a hundred guineas on behalf of its Officers, Council and Members, to the Lord Mayor of London's Hungarian Relief Fund.

The Machine Tool Trades Association have moved to Brettenham House, Lancaster Place, London, W.C.2. The telephone number is Temple Bar 3606/8.

Lumenated Ceilings, Ltd., are now being represented in the North-East area by the parent company, Thermotank, Ltd. In future all local enquiries regarding the Lumenated Ceiling architectural lighting system will be dealt with by Mr. R. E. M. Wilson, Thermotank, Ltd., Tyneside Works, Bede Trading Estate, Jarrow-on-Tyne, Co. Durham. The telephone number is Jarrow 89–7171.

Matthews & Yates, Ltd., announce that they have transferred their Birmingham Office to larger premises at County Chambers, Corporation Street, Birmingham, 2. Telephone number is Central 1089 (2 lines).

National Petro-Chemicals Corporation will be in commercial production of medium-density polyethylenes before the end of this year, it was announced by Dr. Robert E. Hulse, Vice-President in charge of chemical activities for the parent company National Distillers Products Corporation. A high pressure production technique will be used.

At the same time, Dr. Hulse announced that total polyethylene production capacity of the Tuscola Plant will be increased to 100 million pounds-per-year by mid-1957.

L. Richoux Co. (London), Ltd., have been appointed sole agents for the sale of Stonex in the United Kingdom. Stonex is a mineral compound which can be cast to produce inexpensive moulds for low-pressure and vacuum forming. Further details can be obtained from L. Richoux Co. (London), Ltd., 32 Finsbury Square, London, E.C.2.

Mr. Nystrom, Mrs. Daniels, and Mr. Waghorne, photographed at the banquet given by the Swedish Plastics Federation.

Jan-Erik Jansen, the secretary, and Harry Nystrom, the chairman of the Swedish Plastics Federation, at Stockholm.

Exhibitions

Dutch Plastics Exhibition.—Plans for the organization of an International Plastics Fair to be held in the R.A.I. building, Amsterdam, have been prepared. The fair, which is to be called macroPlastic, is to be held from November 13–20, 1957.

The International Plastics Fair is sponsored by the Dutch Authorities, the plastics research station of the Technical University, the Dutch Government Industrial Board and the plastics industry. An advisory committee has been nominated representative of these bodies. The fair will not be open to the public.

Furniture Exhibition.—The annual exhibition sponsored by the British Furniture Manufacturers' Federated Associations and the National Federation of Bedding and Allied Trades will be held at Earls Court again next year (January 23 to February 2) under its new and shorter title, the Furniture Exhibition. In previous years it has been known as the British Furniture Exhibition. The regulations remain, however—only British firms which are members of the Exhibitions Company of the B.F.M. are eligible to show.

Electrical Engineers' Exhibition.—The Minister of Education, the Rt. Hon. Sir David McAdam Eccles, K.C.V.O., M.P., has kindly consented to open the Sixth Electrical Engineers' Exhibition at Earls Court at 12 noon on April 9, 1957.

"Do-it-Yourself" Exhibition.—The Fifth International Handicrafts, Homecrafts and Hobbies Exhibition will be held at Earls Court, London, September 19–28, 1957.

Personal

Mr. C. S. Dingley will be giving up his executive position as Sales Director of B.I.P. Chemicals Ltd. at the end of this year but will remain on the Board. He will also remain a Director of British Industrial Plastics Ltd., The Streetly Manufacturing Co., Ltd., and B.I.P. Tools Ltd. **Mr. S. Gibbs** has been appointed General Sales Manager of B.I.P. Chemicals Ltd. as from January 1, 1957.

Mr. Alfred Brookes, M.B.E., F.P.I., chief chemist of B.I.P. Chemicals Ltd., has been elected by the Council to Fellowship of the Royal Institute of Chemistry.

Mr. D. O. Bremner has resigned from the board of W. S. Electronics (Extruders) Ltd., and is no longer connected with the company. Any enquiries should be forwarded direct to the company.

Mr. R. K. Turner, a Vice-President of Bakelite Company, has been appointed a Vice-President of Carbide and Carbon Chemicals Company. Mr. Turner's activities will be concerned with plastics operations of both Companies which are Divisions of Union Carbide and Carbon Corporation.

Mr. E. J. Gould has joined Richard E. DuPont, Ltd., as sales manager. Mr. Gould will be personally responsible for Government contracts and other large users and act in a supervisory capacity for normal distribution channels at home and overseas.

Dr. C. F. Ferraro has been appointed a research chemist for polymer application research in the plastics and polymers departments of Food Machinery and Chemical Corporation, Organic Chemicals Central Research Centre, where he will be in charge of the physical testing laboratories.

Mr. R. Walsh and Mr. J. B. Ryder have joined the Halex Division of the British Xylonite Co., Ltd., as representatives for their Bex range of housewares.

Mr. H. Rose has relinquished his positions as technical adviser and director of Expandite, Ltd., in order to resume his private practice as Technical Consultant.

Mr. G. Sims-Davies, formerly a district engineer for the British Oxygen Co., has been appointed equipment manager of British Oxygen Gases, Ltd. Mr. R. Fannon has been appointed his assistant.

Mr. F. C. Higgins. It is with regret that we hear of the death of Mr. F. C. Higgins. Mr. Higgins has been closely concerned with the plastics industry since 1923, when he was a pioneer on the mould making side of the industry. He was for many years an active and interested member in both the Plastics Federation and Plastics Institute.

Mr. D. G. Brown, who has been with Universal Plastics, Ltd., since returning from the Forces in 1946, has now been appointed to the Board of Directors.

Mr. G. Brearley.—The Council of the Association of British Chemical Manufacturers has appointed Mr. George Brearley as a director of the Association in succession to **Mr. J. Davidson Pratt** who is retiring in June next year. Mr. Brearley will take up his appointment on April 1, 1957.

Horners' Award Results.—Prize-winners are announced in this year's Horners' Award competition of the British Plastics Federation, to encourage young craftsmen to design articles in plastics materials.

The winner of the first prize, of 50 guineas, is Mr. E. J. Arundell, aged 24, a free-lance designer, of Grassendale Park, Liverpool, whose entry was a design for a portable 17 in. TV cabinet, to be carried out in phenolic and polystyrene materials.

Mr. Arundell will receive his award at a dinner of the Worshipful Company of Horners to be held early next year at the hall of one of the ancient City livery companies.

Other prize-winners were: second prize, 25 guineas, Mr. Brian Smith, L.S.I.A., aged 26, an industrial designer on the staff of E. K. Cole, Ltd., of Southend-on-Sea, for an electric kettle in high-density polythene; third prize, 10 guineas, Mr. K. Brain, aged 22, employed by Bakelite, Ltd., for a two-gallon fire extinguisher in p.v.c.; and, highly commended, Mr. W. D. Harbour, aged 19, of Westcliff-on-Sea, a student at the Central School of Arts and Crafts, Southampton Row, for filing trays of vacuum-formed polystyrene, designed while on vacation work at Monsanto Chemicals, Ltd.; and Mr. J. M. Brennan, aged 28, on the staff of the Royal Scottish Museum, Edinburgh, for a fly-excluding waste-food container in glass-fibre reinforced plastics and melamine.

Meetings

December

18th.—"Heating and Ventilation of Factories," D. T. Jenkins, M.Sc. (Eng.). Incorporated Plant Engineers, Scottish Building Centre, 425/427 Sauchiehall Street, Glasgow, C.2. 7 p.m.

January, 1957

3rd.—"Block Polymer Production by Mechanical Energy," Dr. W. F. Watson. Joint meeting of the Southern Sections of The Plastics Institute and the I.R.I. Chemistry Department, The University, Southampton.

3rd.—"Dust Control," R. J. Pitt. Incorporated Plant Engineers, Peterborough Branch, White Lion Hotel, Church Street, Peterborough. 7.30 p.m.

8th.—"Acoustics and Vibration," W. A. Hines and D. C. Smart. Incorporated Plant Engineers, London Branch, Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2. 6.30 for 7 p.m.

9th.—Cameo Evening. Short papers by Local Section members of The Plastics Institute, Yorkshire Section. St. Marks House, 186 Woodhouse Lane, Leeds.

9th.—"Extrusion of Thermosetting Plastics," T. W. Currie. The Plastics Institute, South Wales and Monmouthshire Section, Angel Hotel, Cardiff. 7 p.m.

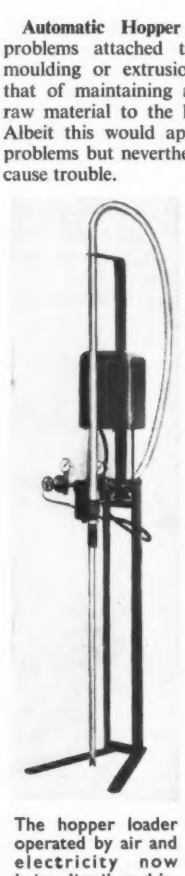
9th.—"Incentive Schemes for Maintenance Work," D. J. Winfield. Incorporated Plant Engineers, Leicester Branch, Bell Hotel, Leicester. 6.30 p.m.

9th.—"Factory Electrical Distribution Systems," R. H. Cobbold. Incorporated Plant Engineers, Western Branch, Grand Hotel, Bristol. 7.15 p.m.

For the benefit of companies who wish to show their products in the February "Plastics in the Service of Man" feature, the subject chosen is *Plastics in Packaging*. Samples or photographs should be sent to the editorial offices.

Automation Equipment

Automatic Hopper Loader.—One of the problems attached to operating automatic moulding or extrusion equipment has been that of maintaining a continuous supply of raw material to the hopper of the machine. Albeit this would appear one of the minor problems but nevertheless it is one which can cause trouble.



The hopper loader operated by air and electricity now being distributed by Fawcett-Finney Ltd.

One solution which, besides being versatile and efficient, has the added commendation of being relatively inexpensive is the Osborn Hopper Loader now being distributed by Fawcett-Finney Ltd.

The Osborn Hopper Loader will lift all types of granular materials in reground as well as virgin form, from a bag, drum or central container to machine hoppers at a height of 15 ft. or more.

The loader consists essentially of a vibrating suction tube, a venturi, a flexible delivery pipe and the necessary control valves and timers. Compressed air fed to the venturi blows material into the hopper, and once a predetermined level is reached the air is shut off and loading ceases until the timer restarts the cycle.

Installation consists simply of connecting up the loader to air and electric supplies, placing the suction tube in a bag of material and the delivery pipe in the machine hopper. Then with 25 p.s.i. air pressure, up to 7 lb. of material per minute can be handled.

Accessories are also available for preheating the air to warm the material being handled. A further advantage is that two loaders can be co-ordinated so that fixed proportions of two materials can be fed simultaneously to the same hopper as for example with the use of virgin and reground material.

Fawcett-Finney Ltd., Berkeley St., Birmingham, 1.

Automatic Level Indicator and Control.—The Telstor is an electronic instrument designed to provide a continuous indication of the level within any type of container. By means of a probe reaching from top to bottom of the container which acts as an electrode an out of balance voltage due to the electrode's change of capacity caused by the rise or fall of material around it is created. This voltage is rectified and measured on a moving coil meter and thus provides a continuous indication of the level. The Telstor can function in practically any liquid or free-flowing solid, almost regardless of viscosity, density, conductivity, insulating value, and in conditions of temperature and pressure removed from atmospheric. As it is not necessary for the material to be in contact with the electrode it can be covered with a heat-resistant or anti-corrosive compound.

The Tektor J. works on a similar principle to that of the Telstor in that the approach or recession of any substance to the probe is detected by a change in electrical capacity. In this case, however, the change in capacitance is made to actuate a relay which can switch in an alarm or start a feeding mechanism to maintain the set level. As with the Telstor the probe can be protected as contact with the material is not necessary for its operation.

Fielden Electronics Ltd., Wythenshawe, Manchester.

Remote Reading Resistance Thermometers.—What are claimed to be the most accurate remote reading resistance thermometers available commercially have been developed by Savage & Parsons Ltd. (Watford, Herts.). They have an overall accuracy of within $\pm 1\%$—according to the meter employed—and a sensitivity of within ± 0.1°C., thus allowing wide ranges of temperature variations to be accurately shown on the $4\frac{1}{2}$ in. uniform scale of the meter.

The thermometers operate on the temperature/resistance change of a platinum sensing element, the small heat capacity of which makes the instrument extremely sensitive to temperature changes, with little time lag. A choice of four models is at present available, covering a range of temperature variations of —50°C. to zero; zero to 50°C.; 50°C. to 100°C.; or 100°C. to 150°C.

The sensing elements, which can be used at a distance from the instrument, are available in flat form, for attachment to surfaces and for interleaving, or alternatively in the conventional immersion form. The thermometer, with its heavy duty battery, forms a completely self-contained unit housed within the casing, and accurate thermometer readings are obtained throughout the 400 hour life of the battery.

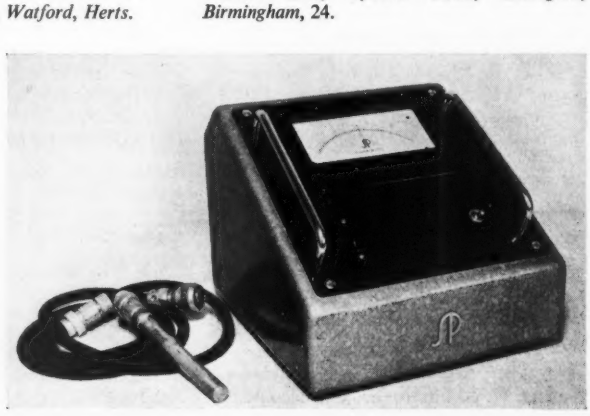
Savage & Parsons Ltd., Watford, Herts.

The Ether programme temperature controller.

Programme Temperature Controller.—This latest product of Ether Ltd., the Transitrol 994, consists of two basic units, the indicating temperature control unit and the time/temperature programme unit. The first of these units operates on a new principle which utilizes a transistor in place of a thermionic valve or other similar components. The measuring system is a conventional galvanometer and indicating pointers operating a photo-electric system of control.

The time/temperature programme unit consists of an electric motor, 230 volts, 50 cycles, mounted in a gearbox positioned below the indicating temperature control unit, which drives the cam on the front of the instrument at a selected speed. In contact with the periphery of this cam is the control arm, which is connected by a pair of precision cut bevel gears to the red index control-pointer of the indicating temperature control unit. The face of the cam is graduated in time and temperature; time being marked from the periphery to the centre and temperature being marked by circles. This system enables a cam to be cut to suit any particular time/temperature programme. A gear-train shown on the back of the gear box permits varying time cycles to be selected. For any given motor a variation of eight speeds can be achieved by changing only one gear of the gear-train. An eccentric screw is fitted to the control-arm which can give Vernier adjustment in correcting the errors in cam cutting.

Ether Ltd., Tyburn Road, Erdington, Birmingham, 24.



Remote reading resistance thermometer unit manufactured by Savage and Parsons Ltd.

TALKING SHOP . . .

Forth Chemicals Plant Extension. Elsewhere in this issue is a report on the new plant at Grangemouth for styrene monomer manufacture. A distinguished party made a one-day trip on November 7 to view the site and I print below photographs taken in the charter Viscount on the way up from London Airport.

At the luncheon at Grangemouth, Sir Miles Thomas, managing director of Monsanto Chemicals Ltd., welcomed the visitors. Lord Polwarth, Chairman of the Scottish Council, replied, and was followed by the Provost of Grangemouth, Mr. D. Chisholm, who is also an employee of Forth Chemicals.

* * *

Back from Russia. In October Mr. H. Bridge, of British Moulded Plastics Ltd., Mr. J. Lesser, of Crystalate Ltd., and Mr. R. Sternberg, of Sterling Moulding Materials Ltd., visited the U.S.S.R. They have made a report to the British Plastics Federation, and on November 28 were present at a special meeting of the London Section of the Plastics Institute at the Waldorf Hotel.

It is quite apparent that the Russian plastics industry, which is organized as part of the chemical industry, is extensive and important. All the materials with which we are familiar are manufactured and fabricated, and if the number of employees per factory is any indication of output, we certainly have no moulding companies anything like as big as the Karbolit Plant at Moscow which has a labour force of 3,500.

The visitors to Russia believe that a large market for the British plastics industry exists there. This is probably especially the case for plant and fabricating equipment. Certainly the Soviet has not lagged behind in developing synthetics on a very large scale.

* * *

Are Metallurgists Human? The other night I went, as a guest, to the annual dinner for the industry arranged by our associate paper *Light Metals*. Identifying myself and my interests tentatively at first, I gradually gained confidence, and found a considerable interest on the part of aluminium experts in plastics—particularly those which are making inroads into the aluminium market. By midnight an accord prevailed that was positively dove-like, and during the course of this neutral period I was able to work out a balance sheet highly satisfactory to plastics; we use aluminium catalysts in ounces—they use synthetic resins for bonding aluminium in tons.

* * *

Dr. Goldstein meets the Press. Dr. R. F. Goldstein was the host at a luncheon to the press on November 19, given by British Oxygen Chemicals Ltd. He reported on the progress made by the company in the field of plastics, noting specially the satisfactory sales of melamine. Although not committing himself to a figure, it is fairly clear that Britain is making some 6,000–8,000 tons a year of melamine resins, a great deal of which is used by the manufacturers of tableware and decorative laminates.

As a sidelight, this luncheon underlined the growing habit of the industry's top brass of taking the press into their confidence. A far cry from a few years ago when the universal reply to a request for information was "no comment."

* * *

Dr. M. G. Church. For long a friend of many in our industry, Dr. Church, of the Ministry of Supply, has just been appointed Assistant Director, Non-Metallic Materials, in the Directorate of Materials Research and Development. This promotion will not however take him from the plastics scene, and we shall be enjoying his company still.

* * *

New Fluorocarbon Plastics. A note in the *Financial Times* of October 26 reports work by Dr. J. A. Young of the University of Florida, on a range of fluorocarbons claimed to be even more stable than the present form. The point of difference is that some of the carbon atoms are replaced by nitrogen.

* * *

Ir. L. C. Stoutjesdijk. The Plastics Research Institute T.N.O. Delft, has just celebrated its 10th Anniversary. The director, Ir. Stoutjesdijk, has seen it grow from a small body to its position today, the largest independent research centre for plastics in Europe. For this growth, he has been largely responsible, no doubt the reason for his nomination to a new post, just announced, that of delegate of the president of the National Council for Industrial Research, the overriding body controlling all Dutch government research institutes. Whilst remaining a member of the governing board of the Plastics Research Institute, he will now have a much wider sphere of responsibility.

His many friends in Britain will wish him success with his new brief.

* * *

Borough Polytechnic Course on Thermoplastics Fabrication. A full-time course from January 2–11 will be held at the Borough Polytechnic, Borough Road, London, S.E.1, covering the fabricating of thermoplastics, including injection moulding, extrusion, vacuum forming, and welding. Lecturers from industrial organizations will participate, and the latest date for enrolment is December 21. Application should be made to the Head of the Chemistry Department, at the Polytechnic.

* * *

Plumbers' Charter. As reported in the *Evening News* for November 3, the Housing Minister has issued a circular in an attempt to reduce damage to houses by frosts this winter. Amongst the suggestions made is the wider use of plastics pipes for cold water services.

After many years of hard work by raw material manufacturers, fabricators, and B.S.I. committees, plastics for domestic piping are now coming into their own.

* * *

Institute News. The Midlands Section, under the chairmanship of Mr. S. F. Sandford, has had some interesting meetings lately. Dr. J. T. Scales talked on "Plastics in Surgery" on October 19, and on November 12, Dr. Grams of Fabwerke Hoechst read a paper on "Low Pressure Polythene."

* * *

B.I.P. Cocktail Party. On November 15 the B.I.P. Group held a party for the presentation, by Mr. C. H. Glassey, managing director, of the Beetle Trophy, won this year by Mr. Charles Parkinson.

PLASTIKON.

Back from Russia (No snow on boots!). L. to R. Mr. R. Sternberg, Mr. H. Bridge and Mr. J. Lesser.

Air party to Grangemouth. L. to R. Mr. D. E. Doyle, Mr. C. E. Spearing, both of British Petroleum Co. Ltd., Mr. D. C. M. Salt, Mr. O. W. Murray, and Dr. W. H. Garrett, Monsanto Chemicals Ltd.

Machines for the Industry

Hupfield 2¼ oz. Injection Machine

A report on the construction and performance of this new machine. The text is related by numbers to the sectionalized drawing shown on the opposite page.

IN the May issue of *Plastics* for 1951 we published a description of the Hupfield 2 oz. injection moulding machine. This model was based on a prototype first manufactured by the company in 1947. Since that time, a large number of these machines have found their way into moulding shops all over the world.

Experience derived from the original 1 and 2 oz. models has been responsible for a number of modifications, these being incorporated into new machines from time to time, with the result that machines manufactured in 1955 offered substantial improvements over the earlier units. It was not until this year, however, that a radical re-design was carried out and as a result of the many changes, including moulding capacity, that have been built into the latest models, we describe here the latest 2¼ oz. machine. One aspect of this unit which calls for special attention is the incorporation of automatic and semi-automatic cycling, the equipment (31, 32) for which will be discussed here. This cycling equipment can be readily adapted and fitted to nearly all earlier models of the 1 oz. and 2 oz. capacity machines.

Fig. 1. A view of the newly designed 2¼ oz. machine, which is equipped for semi-automatic and automatic cycling.

TABLE I HUPFIELD 2¼ OZ. INJECTION MOULDING MACHINE

Specification based on Standard Plasticizing Cylinder using general purpose Polystrene

	2¼ oz. Machine
Maximum speed of operation (dry run cycle)	7 sec. cycle
Full 1 oz. and 2 oz. shot can be moulded consistently (subject to mould design)	17 sec. cycle
Moulding area	22 sq. in.
(This can be increased where mould permits reduction of injection pressure)	
INJECTION END—	
Plasticizing capacity per hour ...	40 lb.
Diameter of injection plunger ...	1⅝ in.
Stroke of injection plunger ...	8 in.
Injection pressure with standard plunger	12,120 lb. p.s.i.
Rate of injection per second ...	4.1 cu. in.
Hopper capacity	12 lb.
Heating unit consumption ...	2.8 kVA.
MOULD END—	
Mould locking pressure	44 tons
Mould opening	7 in.
Combined thickness of mould ...	5½ in.
Space between tie bars	13½ in.
Height of centre of platen from bed	6 in.
GENERAL—	
Rating of 3-phase electric motor at 50 c.p.s.	8 h.p.
Capacity of hydraulic pump ...	6.5 g.p.m.
Maximum pressure on hydraulic system	2,000 p.s.i.
Capacity of oil tank	30 gallons
Water cooling at head of approximately 30 ft.	180 g.p.h.
Net weight (less oil)	23 cwt.
Shipping weight	27 cwt.
Overall length, width and height of machine	6 ft. 10 in. x 2 ft. 2 in. x 4 ft. 2 in.
Shipping dimensions	7 ft. 3 in. x 2 ft. 9 in. x 4 ft. 8 in.

Construction

The base of the machine is of welded steel construction incorporating the control box (1), hydraulic power unit and control valves. The hydraulic power unit comprises a Dowty gear pump (2), coupled direct to a Brook 8 h.p. motor. A line pressure is employed of 2,000 p.s.i. and the pump is immersed in a large capacity oil tank which is water cooled and completely covered to prevent contamination of the oil.

The control box contains an isolating switch (3), remote control (4), operating a motor starter, and electronic equipment for controlling temperature. The isolating switch, manufactured by Crabtree is coupled with the door and has to be switched off before the door can be opened. The motor starter is of a new design, manufactured to American and Canadian standards by the Midland Electrical Manufacturing Company. Temperature control equipment is of the "Tem-Con" type manufactured by P.A.M., Ltd., and provides an accuracy of control of ±½° C.

The control valves include a combined 4-way and relief valve (5) mounted on the under side of the bed of the machine, operated by a safety cam (6) through the mould closing mechanism. Standard equipment also includes a sequence valve and an independant variable injection pressure valve (7), both mounted inside the machine and adjustable by controls on the panel (8).

The locking mechanism comprises a large

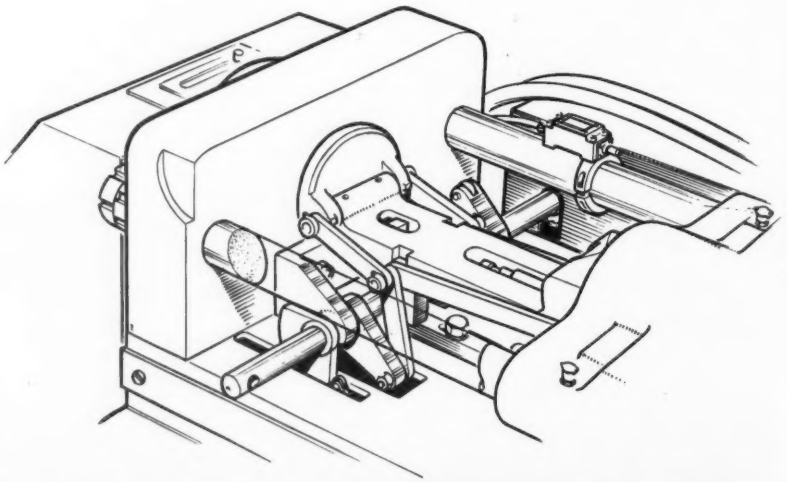
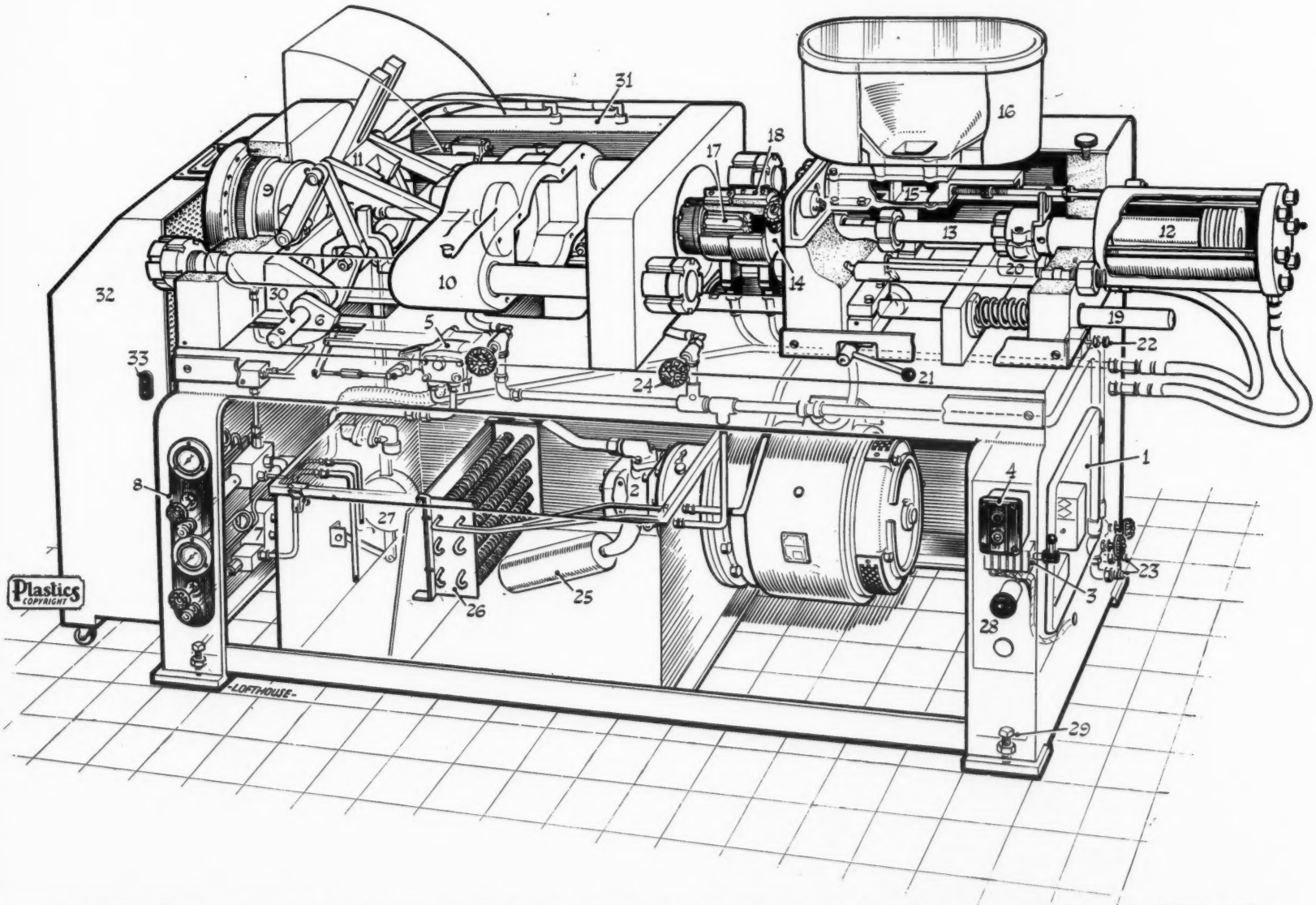


Fig. 2. Details of the locking mechanism, which provides a 44 ton locking pressure.



Hupfield 2¼ oz. Machine. Key to Drawing:—1.—Control box; 2.—Pump; 3.—Isolating switch; 4.—Remote control; 5.—Four-way valve; 6.—Safety cam; 7.—Variable injection pressure valve; 8.—Valve controls; 9.—Locking piston; 10.—Moving platen; 11.—Link system; 12.—Hydraulic cylinder; 13.—Injection ram; 14.—Plasticizing cylinder; 15.—Auto-feed; 16.—Hopper; 17.—Torpedo; 18.—Heater bands; 19.—Slide bars; 20.—Jacking cylinder; 21.—Cam lever; 22.—Shut-off valve; 23.—Inlet and outlet water connections; 24.—Water control valves to mould; 25.—Oil filter; 26.—Oil cooler; 27.—Counterweight; 28.—Indicator lamp; 29.—Levelling bolts; 30.—Mould closing spindle; 31.—Auto drive unit; 32.—Auto control unit; 33.—Auto/single cycle selector switch.

area single acting piston (9) acting through a high tensile steel pressure bar. A 44 ton locking pressure is provided with this mechanism which, with the variable injection pressure obtainable, frequently enables the operator to exceed the guaranteed 22 sq. in. of moulded area. The pressure bar is coupled direct to the moving platen (10), the platen being opened and closed through a dual link system (11) which incorporates a safety action preventing any possibility of hydraulic load being applied to it. This is effected by the centre of the link system which, being spring loaded, is depressed below the centre line when the machine is in the closed position.

The injection mechanism comprises a retractable unit consisting of a double acting hydraulic cylinder (12), injection ram (13), plasticizing cylinder (14), self-compensating auto-feed (15) and large capacity hopper (16).

The whole of the injection mechanism has been designed to give an ultimate injection pressure of 12,450 p.s.i. Of particular interest to the industry will be the fluted torpedo (17), designed by Hupfield's, to give maximum heat transfer to the material by increasing the exposed metal surface. In addition, there is a considerable decrease in the pressure losses normally encountered, and a consequential improvement in material flow into the mould.

Two heater bands (18), giving a total output of 2,800 watts, supply the plasticizing heat, the thermocouple being located under the larger band. These are controlled by a sensitive element actuating an electronic amplifier (already noted) in the control box. Mains frequency induction heating can be supplied as an alternative extra.

The injection mechanism is mounted on a retractable unit, moving on slide bars (19) and powered by a spring-return single acting jacking cylinder (20). The cam lever (21) can be moved to hold the whole unit in the forward position during moulding if required. Alternatively the unit can be held back by operation of a positive shut-off valve situated on the end of the machine (22). This enables material to be purged into the gap between the nozzle and the mould, facilitating colour and material changing. Test runs on the 2¼ oz. machine have enabled colour changes to be carried out in under two minutes.

Water cooling is incorporated for both halves of the mould.

The general details are given in the specification in Table 1.

Semi-Automatic and Automatic Cycling

After considerable research and experiment the automatic cycling attachment (see Fig. 3) has been devised. Constituting an all-welded assembly, the unit is mounted on castors and has its own power unit, a 1 h.p. motor driving a Dowty gear pump through to a double solenoid 4-way valve. The solenoids are controlled by two Chamberlain and Hookham timers, seen clearly in Fig. 3; these can be supplied with locking devices if required. Also shown in the panel is a cycling counter.

The automatic cycling attachment is linked to the driving unit by means of flexible hydraulic lines. The driving unit is mounted on the side of the machine and consists of a double acting double-ended hydraulic cylinder the piston rods of which are connected to drive chains moving over the driving sprocket and the idling sprocket. The driving sprocket is connected to the extended end of the normal mould closing spindle.

The safety gate initiates all moulding sequences by actuating the starter switch. If for any reason the gate is opened during any sequence the moulds immediately open and the injection ram returns to the start position.

Fully automatic cycling is carried out by use of an electro-pneumatic time delay relay which is also capable of giving a variable dwell during the mould open position.

Provision is also made for variable mould closing pressure, and an adjustable stop is incorporated in the cylinder head to prevent damage to moulds by misplacement, or faulty ejection. The unit is thus equipped with mechanical as well as other safety devices.

The automatic cycling unit permits, of course, very much closer control over the moulding cycle when it is in operation than is possible by hand operation. By fitting the automatic control in a separate unit, the electrical equipment is protected against damage by vibration from the injection machine itself.

By uncoupling the driving chain and inserting the mould closing lever, the machine can be reverted to hand operation in a matter of seconds.

We acknowledge the help given by Hupfield Brothers, Ltd., Dalston Gardens, Stanmore, Middlesex, in the preparation of this report.

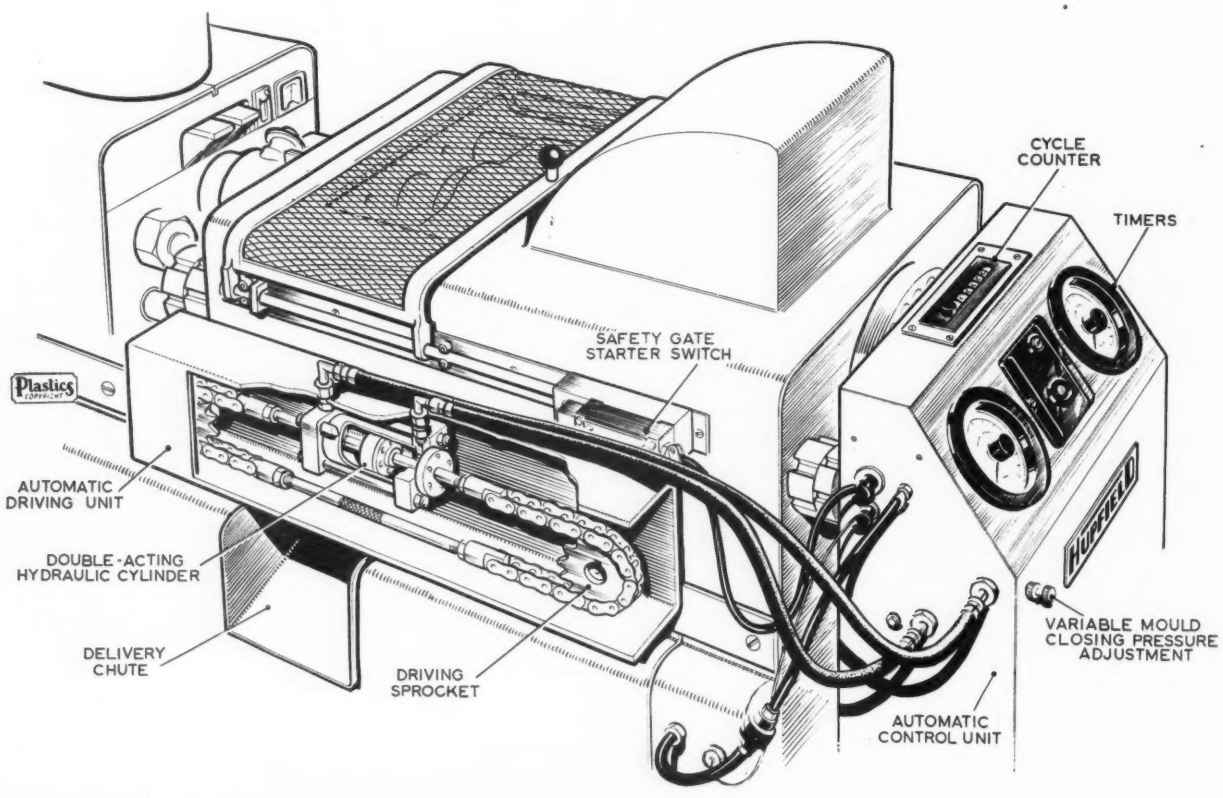


Fig. 3. The automatic cycling equipment, linked to the control unit shown to the right of the drawing.

Metallic Soaps

By M. D. CURWEN, B.Sc., A.R.I.C.

Extracts from a paper read before the London Section of the Plastics Institute on October 17, at a meeting for junior members. The author considers metallic soaps as raw materials, and reviews some of their applications

"SOME time ago Sir Eric Rideal who has done so much work on polymers, made an appeal that has been voiced by many people with experience in industrial chemistry. He said that all students should be taught as much as possible about the raw materials of industry. I am sure this is essential and moreover we should learn about them whether they are used in the industry of our main activity or outside it.

"I have chosen for this lecture the field of metallic soaps, because very little has been written about them and because far more is still to be known about them than has been discovered since they were first produced about 50 or 60 years ago.

"The industry is not a big one, but neither is it a small one, for the world's production must be over 250,000 tons and may be as high as 500,000 tons. The applications are very widespread and many are of more than passing interest. To one industry they are entirely and completely essential since it could not possibly exist in its present form without them. I refer to the paint industry.

"Metallic soaps are combinations of metals with certain organic acids, the name 'soaps' being given to them, by chemists in the field of manufacture of the ordinary alkali metal soaps, that is the washing soaps, who first discovered them by adding water soluble metal salts to sodium soaps of high molecular weight, a simple process that is still the main one today. The two types have great differences. The metal soaps are more or less completely insoluble in water. Moreover, or because of this, they do not foam or have any detergent power. But there is one common denominator. In their respective fields, both the alkali soaps and the metallic soaps exhibit high surface activity."

The speaker then described methods of production, indicating the sources of suitable acids, the bulk of which come from fats, oils and waxes. Only a small number are in fact used in soap manufacture, and the most important were described, viz.: straight chain saturated types such as stearic and lauric acid, unsaturated acids, such as oleic, rosin and tall oils (that is, abietic acid), petroleum acids, notably naphthenic, and synthetic acids, such as octoic acid. The speaker then went on to describe the influence of the acid on the metal soaps themselves.

"Now, I have said that the great difference between the ordinary or alkali soaps and the metal soaps lies in the solubility in water of the first and the insolubility in water of the second.

"But there is an important difference between the metallic soaps themselves. Those made from the straight chain saturated acids, the laurates, palmitates and stearates and dibasic acid, etc., are more or less insoluble in oil. Thus lead stearate is almost completely insoluble in oil or other solvents, even in benzene. It is soluble in hot benzene but it completely drops out of solution on cooling. Therein lies the importance of these soaps in certain industries.

"On the other hand those made from unsaturated acids like oleic, linseed oil fatty acids, are more or less soluble in petroleum oils, and many other organic solvents. Equally, therein lies the importance of this type of metallic soap in certain other industries.

"Even better in this respect are the soaps made from the naphthenic acids and the synthetic octoic and nonanoic acids, which although saturated acids are ring or secondary compounds and form metallic soaps that are infinitely soluble in all organic solvents except the low molecular weight alcohols, e.g. ethyl alcohol.

Metallic Soaps from Acids

"The metallic soaps derived from these acids as I have already said are divided into two types:—

(1) The oil insoluble type from straight chain saturated acids, e.g. lauric, palmetic and stearic acids.
(2) The oil soluble type made from oleic, linolic and linoleic mixtures, naphthenic and octoic acids.

The methods of making both types are similar, namely double decomposition, but differ in detail, because of the different characteristics, but the general formula for making any metallic salt is:—

$$\text{R. COOH} + \text{NaOH} = \text{R. COONa} + H_2O$$

$$2\ \text{R. COONa} + Pb(NO_3)_2 = \begin{matrix}\text{R. COO}\\ \text{R. COO}\end{matrix}\!\!\diagdown\!\!\diagup Pb + 2\ NaNO_3$$

or if aluminium (say aluminium stearate):—

$$6\ \text{R. COONa} + Al_2(SO_4)_3 = \begin{matrix}\text{R. COO}\\ \text{R. COO}\\ \text{R. COO}\end{matrix}\!\!\diagdown\!\!\diagup\!\!\diagdown Al + 3\ Na_2SO_4$$

"Now this is followed by different treatment according to whether the acid is a straight chain saturated acid or an unsaturated acid (oleic) or naphthenic acid. Remember that I said that the two types of metallic soaps differ, although both are insoluble in H_2O and are deposited in the reaction vessel. The straight chain soaps are not only insoluble in oil but have a higher melting point than that of boiling water. The unsaturated type soaps and the naphthenic soaps are of low melting point and are more or less fluid.

"Thus the palmitates, stearates, etc., can be separated from the water using a filter since they are in a crystalline-like form, can be washed free from water and salt in the filter press, can be handled quite readily and dried on trays in a hot-air oven and finally ground to a fine powder.

"The oil soluble soaps on the other hand all melt to a very sticky amorphous mass in the boiling water which is separated out while in the reaction vessel. Washing with clean water and boiling repeatedly to remove Na_2SO_4, $NaNO_3$, etc., follows.

"The soap is then heated to remove all traces of water. The final material when cold may be very soft like zinc or lead, or hard and brittle like cobalt and manganese—all have cold flow. Alternatively solvents such as white spirit is added to dissolve the soap and the solution is pumped out."

In dealing with the uses of metallic soaps, the speaker noted first that the oleates and linoleates, formerly widely used in the paint industry, have been almost entirely replaced by the naphthenates. The great bulk of soaps today are the stearates, laurates, and sebacates in the oil insoluble class, and the naphthenates in the oil soluble form. The major uses were then defined.

"**1. Lubrication.**

"(*a*) Greatest outlet is for manufacture of lubricating greases which are solid or semi-solid emulsions of oil and stearates of calcium, sodium, zinc, etc.

"(*b*) Zinc stearate for lubricating moulds.

"(*c*) Extreme pressure. Zinc and lead naphthenates for hypoid gears and also magnesium naphthenates for transformer oils.

"(*d*) Metal cutting. Zinc naphthenate.

"(*e*) Prevention of gumming and deposits in lubricating oil with Sn. and Cr. also long chain amines.

"**2. P.V.C. Stabilizers.** Pb, Ca, Cr, Sn, stearates, palmitates, laurates, phthalates. Perhaps also the tin complexes with lauric acid may be considered as soaps.

"Somebody has suggested that zinc and lead naphthenates can be employed in this field, but it should be remembered that the naphthenates are all very easily soluble in oil so that I do not think they can quite safely be used where the p.v.c. is used where oil is present. Obviously for water tubing, e.g. garden hosing they would be quite suitable."

The speaker also mentioned waterproofing of textiles, rot and fungus proofing of wood and textiles, tackifiers for synthetic rubber, horticultural applications, anti-corrosion applications, used in boilers, protection of acrylic lenses during manufacture, and use in the bending of metal tubes.

Catalysis

"I should now like to add a few words about the use of metallic soaps as catalysts for it is not impossible that the use will increase, perhaps in the petrochemical industry and elsewhere. As you all know a cobalt catalyst is used in the cross-linking of polyester resins with unsaturated monomers like styrene.

"But the widest use is and always has been in paint technology. For very many centuries the hardening of oils of the drying or semi-drying type used as protection of wood and metals was achieved by incorporating metallic oxides into the oil—probably natural iron oxides and lead oxides were the first, and a similar technology was used probably in very primitive paintings. But it has been only during the last 50 or 60 years since the soluble metal soaps have been produced that it has been realized it is only when the metal is made

soluble in drying oil that catalysis (i.e. oxygen carrying) is achieved reasonably rapidly."

The speaker then noted that whilst cobalt, manganese, and vanadium are regarded as the supremely "drying" metals, the function of lead, zinc, calcium and other soaps is far less clear, although they are employed by the paint industry, particularly in combination with the drying metals to give improved results.

"This action of combined catalysts which results in effects greater than the sum of each working alone, is, as you know termed synergism, but what this really means has long been a puzzle.

"Today, the paint industry regards the formation of a film from a drying oil (e.g. linseed oil, with or without combined resins, alkyds, phenolics, epoxies) as involving the formation of hydroperoxides, the reactions created by these hydroperoxides so that cross-linking takes place, the growth of the polymers thus made, the formation of colloidal disperse phase particles and their aggregation to form a continuous (solid) phase. All these chemical and physical processes overlap and are lumped together and called "drying." To accelerate it, the metal catalysts or driers as they are called in the paint industry, are added. As one well-known physico-chemist has written, 'Small wonder that driers react in unaccountable ways.'

"The same writer, Dr. R. F. Bowles, in an effort to understand more of their specific roles, carried out a series of experiments and classified naphthenates as powerful surface active agents with a general tendency to act as flocculating or non-flocculating agents by virtue of their activity at interlayers.

"To obtain some confirmation of this, he prepared a partially polymerized linseed oil (by heating to 285° C.) and added cobalt naphthenate to it, bringing the cobalt metal content to 0.01% by weight. He made this stock solution the basis of a series of solutions containing additions of 2% of a number of metal naphthenates and then proceeded to make films of each of them. The table here shows the gelation time of each.

INFLUENCE OF NAPHTHENATES ON GELATION TIME (25° C.)

(Control contains 0.01% Co calculated as metal)

Naphthenate Added (2%)	Calculated as Metal	Gelation time (hours)
Nil		7
Lithium	0.03%	6
Zinc	0.20%	4
Lead	0.48%	3½
Calcium	0.10%	3½
Cobalt	0.16%	3½

"Dr. Bowles concludes, 'It is not surprising that the large amount of cobalt naphthenate added to the oil has halved the drying time, but the same is true of adding zinc, lead and calcium in the form of naphthenate. These three metals are almost without effect on the drying of linseed stand oil in the complete absence of cobalt and it seems probable therefore that their function is to assist in some way to flocculate the disperse phase polymers and to organize them into a film. Thus a reasonable explanation of the use of zinc, lead and calcium "driers" is at last forthcoming.' And, I might add, this seems to give us a real meaning to the word 'synergism.'

"Synergistic action has also been claimed with mixtures of two different oil-insoluble metallic soaps used as stabilizers for p.v.c. since the reaction is normally considered to be purely chemical and stoichiometric, an explanation for this type would be useful.

Conclusion

"Here I think, I can end my talk, but I should like to say how much I believe, which some have denied, in a possible analogy with polyester cross-linking and glass fibre/polyester technology. At least, you may know that some work to evaluate accelerators including others than cobalt is being carried out in the National College. Whatever the results, the work should prove at least interesting and it may even prove valuable."

Perlon Belts in Rolling Mills

THE longest rolling mill drive belt so far produced in a weaving mill in Germany has been running for some time in three-shift working in a large Belgian ironworks. The special Perlon belt, which permits of increased production, is 200 ft. long, 31 in. wide and approximately ½ in. thick. The belt, of other origin and other material, previously used there had had to be shortened 38 times on account of the extremely heavy loading. A similar belt fitted in a German steelworks is 130 ft. long and 59 in. wide. By this, belt capacities of up to 5000 h.p. are transmitted, practically without slip, from an electric motor which can be 100% overloaded to a flywheel of 30 ft. diameter.

On account of the impossibility of mounting such a belt in an endless form, the ends were woven together by specialist fitters on the site, without taking down bearings or belt pulleys. Therefore the joint was not made by clipping, cementing or welding. The belt was not weakened at the point of connection and the seam had a breaking strength of approximately 1000 kg/sq. cm. to match the rest of the belt material.

Perlon high-capacity driving belts have recently been coated with p.v.c. The p.v.c. surface represents an important further development and has, as comprehensive practical tests have shown, been found outstandingly good. The already very high tearing and bending strength and non-slip properties of Perlon high-capacity driving belts are essentially increased. It is now possible to use far thinner Perlon belts, which is of advantage particularly with high-speed drives. Endless woven belts run entirely free from whip, and with little noise.

The advantageous properties may be characterised as follows: substantial and desirable holding and non-slip properties. On account of this holding on the pulleys, belt tightening, necessary hitherto, is no longer required; unaffected by many acids, petrol, oil or moisture; reduction of elongation, with its undesirable consquences as met with other kinds of belt, to a minimum; belt preservatives such as oil, wax or paste no longer required; the p.v.c. component is not sticky and thus no soiling or caking of the pulleys; quiet running, entirely free from whip.

The belts are suitable mainly for transmitting high capacities such as, for example, for the drive of compressors, generators, pit fans, hollanders, briquette presses, etc. In short, in these special belts, we have a novel drive element, which can be used almost everywhere and above all with high speed machines, short distances between shaft centres or with slow speed machines.

A few details of the special belts may be briefly mentioned as follows:

Breaking strength: approx. 1700 kg/sq. cm. (total cross-section).
Tensile strength: approx. 1600 kg/sq. cm.
Ultimate elongation: approx. 15–30%.
Supplied in any dimensions required.

The crux of the development work was the production by a Krefeld firm of the Perlon rolling mill belt. This type of belt has been found satisfactory with the heaviest plants of various rolling mills. Plants before considered as belt "gluttons" are today working with enormously reduced wear after fitting with these new belts. With rolling mill drive heavy intermittent loading has to be reckoned with; the belt is therefore stressed to the utmost with requirements of the material and workmanship. On account of the elasticity of the Perlon material, belts made of it intercept any shocks, absorb them and keep them away from the bearings. Another advantage is that after the actual fitting, no further shortening is required and no actual losses of production occur on account of such work. This fact should not be underestimated when it is realised what losses can be suffered when several machines are put out of action by failure of a driving belt.

On account of the high resistance to wear of the Perlon cables and yarns, and the great frictional and bending strength of these, it is possible to reduce the thickness of this type of belt. This again favours good holding on the belt pulley. Whilst to begin with such belts called for the experience, knowledge and reliability of specialists gained over years, they can now be installed on plants with fully rigid shifts.

With high-revolution plants, a speed is obtained in practice with these belts of over 330 ft./sec. in continuous operation, since, as distinct from the rolling mill belts described in the beginning, they can be made in lengths of sometimes less than 19 in.

By the greater tearing strength, it is now possible to reduce the thickness of the belts hitherto used. With high revolution drives, this fact is particularly favourable. The fatigue of the raw material with heavy bending stresses is also combated by this, and a longer life obtained.

In order to illustrate the enormous tearing strength of the special belt it may be mentioned, as an example, that belts supplied to Belgium of 3 ft. × ½ in. had an ultimate breaking strength of over 126,000 kg.

High Density Polythene

By J. S. GOURLAY, Ph.D., B.Sc., F.R.I.C.,* and M. JONES, B.Sc., F.I.R.I.†

This paper was read at the Swedish Plastics Federation Convention in Stockholm in October. We are pleased to publish it here, in association with the Swedish Federation. The authors discuss the methods of manufacturing high density polythene, physical properties, processing behaviour, and applications.

Introduction

WHEN ethylene was polymerized to a high polymer 20 years or more ago, most of us thought of the polymer as a very straight chain in which $—CH_2—$ (methylene groups) were linked together. Chemical analysis told us that the empirical formula was $(CH_2)_n$ and the properties were those of a remarkable but unmistakable aliphatic hydrocarbon.

The last 25 years, however, have been characterized by a spectacular growth of physical methods of analysis such as:—

(i) Infra-red and ultra-violet spectroscopy,
(ii) Osmometry of large molecules,
(iii) Viscometry of large molecules,
(iv) X-ray diffraction analysis,

and so on.

These powerful physical methods have shown beyond doubt that the simple picture we formed when these ethylene polymers were first discovered is not accurate so far as commercial polythene is concerned. Indeed, we can now write down the important variables for the simple but erroneous structure first envisaged for commercial polythene.

FIG. 1. STRAIGHT CHAIN $X—(CH_2)_n—Y$

Property	Value
Melting point	> 136.5° C. < 150° C.
No. average molecular weight...	Up to about 1,000,000
Nature of the chain	Straight unbranched
Repeating unit	$—CH_2—$
Nature of end groups	X and Y
Degree of crystallinity	Nearly complete
Density at 15° C.	1.00
Distance between carbon atoms	1.53 Å
Angle between C—C bond ...	112°
Dimensions of the rectangular unit cell	a = 7.42 Å b = 4.94 Å c = 2.54 Å
Space grouping	Orthorhombic
Degree of unsaturation ...	About 1 double bond per molecule.

A polymer conforming to the specification in Fig. 1 would in the classical sense be a perfect high density polythene, and by the direct but completely uneconomic route through diazomethane, polymers approaching this limiting type of polymer have in fact been made in the laboratory. Such polymers, however, are not nearly so easily fabricated into useful articles as commercial polythenes, and it may be regarded as extremely fortunate that the first polythenes did not conform to this limiting high density type of product, because the ease of working and shaping of polythene, for example, are largely determined by the radical departure of the commercial polythene from the specification in Fig. 1.

"Alkathene," the first commercial polymer, was branched and not simply a straight chain. Further, since the degree of crystallinity decreases with increasing branching, properties dependent upon crystallinity such as density, melting point, Young's modulus in tension, yield point and surface hardness, vary with the degree of branching. The easy working properties of polythene are, therefore, to some extent associated with the decrease in crystallinity, i.e. with the presence of amorphous regions in the solid polymer.

On the other hand the ultimate tensile strength, the elongation at break and the low temperature brittle point, are more dependent on the degree of entanglement of long chain molecules, and in particular, on long range entanglement, i.e. essentially on molecular weight rather than on degree of branching or crystallinity of the polymer.

With these ideas in mind we can classify the polythenes in a very practical and simple way. (In general regular polythenes have a density of .92 ± .005.) High density polythenes may, therefore, for the sake of convenience be regarded as those products lying above this range. Admittedly this is an arbitrary division as the whole tendency now is to produce a wide spectrum of products with densities—and other properties—varying from those of the original polythene ("Alkathene") to those corresponding to a density of about .96.

The following shows the trend in property change with change in density.

FIG. 2

Regular polythenes	High density polythenes
Lower density	High density
Lower melting point ...	Higher melting point
Lower surface hardness ...	Greater surface hardness
Lower stiffness	Greater stiffness
Easy to fabricate	More difficult to fabricate

It is clear, therefore, that the two groups of products will be complementary to each other and that there will, in fact, be a whole spectrum of materials with different properties and different behaviour. So long as price factors remain more or less equal the user will have a choice of raw material determined by the specific properties he requires, and the processing conditions he is able to tolerate.

Commercial Methods of Production of High Density Polythenes

The first solid polymer polythene which can be described as of commercial importance was discovered in 1933 by I.C.I. Before that time liquid polymers were well known and polymethylenes were described in the scientific literature many years before.

The last European War gave a tremendous impetus to the commercial development of polythene and by 1954 polythenes covered by I.C.I. patents had achieved a major industrial success in a wide range of applications including cables of all kinds, but particularly, submarine and radar communication cables, mouldings, particularly for industrial and household uses, and film for packaging in its widest sense.

It was about this time, too (1954), that hints of other routes to polythene began to make news; and now there are probably three broad methods by which such products can be produced. Very briefly, these methods are:—

FIG. 3

Process	Catalyst	Density range of product
1. High pressure	Free Radical	0.900–0.955
2. Low pressure	Supported Oxide	0.955–0.970
3. Low pressure	Metal Alkyls	0.945–0.955

Process No. 1 in Fig. 3 is that which has so far been operated and discovered by I.C.I. Process No. 2 is covered by patents in the names of Phillips Petroleum Company and Standard Oil of Indiana, and the third is the Ziegler process.

In general, while the patent literature does suggest very broadly the routes to the polymer, it must be recognized that these are still secret processes so far as details are concerned. Nevertheless, it is clear that metal alkyls and supported oxide catalysts tend to yield high density polythenes while the free radical high pressure process can, with modifications, presumably in respect of pressure, temperature and catalyst, yield a very broad range of products.

Supported catalysts have been the subject of patent applications, notably by Standard Oil of Indiana and the Phillips Petroleum Company and others. The catalysts mentioned by the Standard Oil Company fall into two groups:—

(1) The metals nickel or cobalt supported on charcoal.
(2) The oxides of transition metals of Group Va and VIa supported on alumina, titania or zirconia.

The second group is presumed to be used in the projected commercial process, the preferred metal being molybdenum. The metal in the oxide must be in the sub-maximum valency state. In all cases, excepting the high pressure free radical process, the polymerization of ethylene takes place at temperatures above 100° C., pressures about 1,000 p.s.i., and in the presence of liquid hydrocarbons which serve to dissolve the polymer and maintain the activity of the catalyst. The catalysts are sensitive to air and water, and the process must be operated under dry and reducing conditions. Regeneration of the catalyst is necessary from time to time and may be accomplished by high temperature hydrogenation. The polymer is separated from the solvent by evaporation and is then fractionated by a solvent process to separate the high polymers from liquid or greasy products.

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The Phillips Petroleum Company's published patent specifications refer to the active catalyst chromium oxide in the sub-hexavalent state. This is supported on steam activated granular silica-alumina. It is necessary that part of the chromium should be in the hexavalent state, otherwise no polymerization occurs and the catalyst may be further activated with, for example, strontia. As in the Standard Oil process polymerization is carried out in a liquid hydrocrabon medium at moderate pressures and temperatures, and similar evaporation and fractionation treatment is involved.

The polymerization of ethylene by the use of certain metal alkyl catalysts has been known for many years. K. Ziegler recently discovered (*Angewandte Chemie*, 1952, **64**, 323–9) that aluminium alkyls were effective and he explained the process as involving first a growth reaction, in which ethylene molecules are inserted stepwise between the aluminium atom and the alkyl group, and subsequently a displacement reaction in which the long chain alkyls are displaced by ethylene leaving an aluminium ethyl derivative.

FIG. 4. ETHYLENE POLYMERIZATION

$$>Al-R + C_2H_4 \longrightarrow >Al-C_2H_4.R \text{ and so on}$$
$$>Al(C_2H_4)_nR + C_2H_4 \longrightarrow >Al-C_2H_5 + CH_2{:}CH-(CH_2)_nR$$

Ziegler later found that by reacting alkyls of metals of Groups II and III with compounds of transition metals in Groups IV and VI insoluble coloured products were formed which could polymerize ethylene. A particularly effective catalyst is obtained by mixing hydrocarbon solutions of titanium tetrachloride and aluminium triethyl. In the absence of oxygen and water, which destroys the catalyst, ethylene is polymerized rapidly at atmospheric pressure, the process starting spontaneously from room temperature. Reaction temperatures rather above 50° C. are preferred.

The first products obtained in this way were of very high molecular weight, and impossible to fabricate by normal techniques. Polythenes of molecular weight low enough for processing, in normal plastics fabricating machinery, have been made by an appropriate choice of the proportions of metal alkyl and transition metal compound used in preparing the catalyst.

The polymerization is carried out in a low boiling organic solvent. The polythene appears as an insoluble precipitate. It is then necessary to filter off the product, remove the solvent, and treat it to remove the catalyst residues. The product must then be melted, cooled and cut into one or other of the usual granular forms.

The foregoing is an attempt to present the background to the development of a new range of polythenes. We will now proceed to a more detailed consideration of properties and processing behaviour of a range of materials with different densities.

It is, however, important to point out that the relationship between properties and densities is an approximate one, for sufficient points on the curve have not yet been obtained to establish the precise dependence of one upon the other, and furthermore, a sufficiently wide range of materials of different densities produced by a single processing method has not yet become available. Nevertheless, sufficient is known to draw certain general conclusions.

Not all the physical properties of polythene are improved by increasing the density and a careful study of the data will suggest that as the density rises there is a tendency towards great brittleness. This, in fact, is the case and the production of high density polythenes demands that the molecular weight should also be raised in order to eliminate this possible weakness. Thus, in the end a compromise has to be made between high density, high molecular weight and ease of processing.

The most obvious changes in physical properties brought about by an increase in density are higher strength and greater stiffness, and a higher softening point. In general, these changes are directly proportioned to the density but this does not necessarily mean that the highest density product is automatically the most acceptable for any given purpose, or for any given set of processing conditions.

The general physical picture is seen from Fig. 5.

This indicates that in the case of "Alkathene" HD—a product with a density of 0.94—the tensile strength at break has increased by about 70% compared with "Alkathene" 2, while the vicat softening point has increased from 91° C. in the case of "Alkathene" 2 to 116° C. for "Alkathene" HD. At the same time the stiffness modulus has increased by over 100%. On the other hand, the elongation at break shows a very definite adverse trend.

FIG. 5

Property		"Alkathene" HD	"Alkathene" 2	"Alkathene" 20
Melt flow index (Grade No.)		0.7	2	20
Density gm./c.c		0.94	0.92	0.92
	Rate of strain			
Ultimate tensile strength (lb./sq. in.) at 20° C. ...	6 in./min.	2,680	1,890	1,600
	12 in./min.	2,750	1,880	1,580
	18 in./min.	2,900	1,800	1,500
	30 in./min.	3,200	1,690	1,400
Elongation at break %	6 in./min.	380	450	450
	12 in./min.	300	490	490
	18 in./min.	200	490	490
	30 in./min.	180	500	500
Vicat softening point °C.		116	91	83
	Temperature			
Stiffness modulus in tension (2% secant) in lb./sq. in.	25° C.	41,000	19,500	—
	60° C.	19,200	6,000	—
	80° C.	15,400	3,800	—
	100° C.	6,600	1,000	—
Crystalline melting point °C.		120–124	106.5–109.5	—
Abrasion resistance, grams/100 cycles (Taber index) ...		19×10^{-3}	23×10^{-3}	42×10^{-3}

These characteristics are seen more clearly in the following series of graphs and tables:

Fig. 6. Effect of density upon softening point.

Fig. 7. Effect of density upon stiffness.

Fig. 7a. Effect of temperature upon stiffness.

Fig. 8. Relationship between density and stress/strain characteristics.

Fig. 9. Relationship between elongation at break and density.

Fig. 10. Relationship between density and tensile properties.

Fig. 11. Effect of speed of test upon elongation at break.

Fig. 12. Variation of gas permeability with density.

Fig. 13. Variation of vapour permeability with density.

Fig. 14. Variation of the absorption of organic liquids with density.

Special reference should be made to Fig. 11 which sounds a warning about a possible weakness in high density polythene—namely, the substantial fall in elongation at high rates of stretch. The elongation at break of regular low density polythene is substantially unaffected by rate of extension—at least within the range of speeds normally used in the testing of plastics and rubber. In the case of high density polythene, however, there is a fairly severe fall—the greater in the case of the higher densities. This undoubtedly is an indication of a greater tendency to brittleness which may be a hazard under some service conditions, although it is important to point out that the low temperature brittleness of high density polythene is not substantially inferior to that of low density polythene.

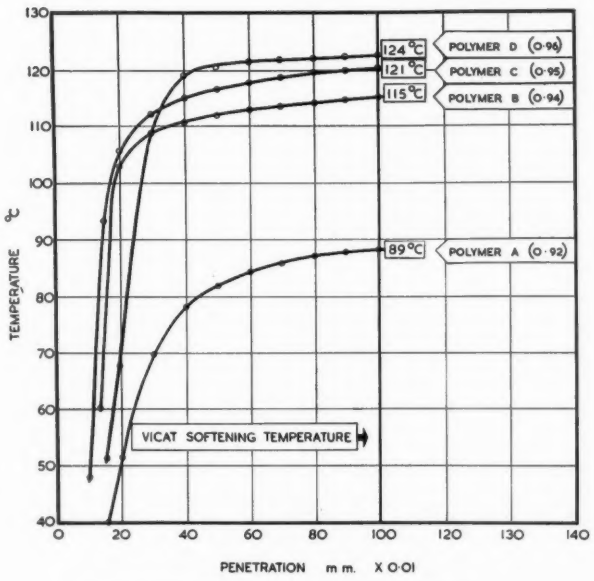
This difference in behaviour is of course, a very clear indication of a fundamental difference in structure between the relatively amorphous low density material and the highly crystalline high density material.

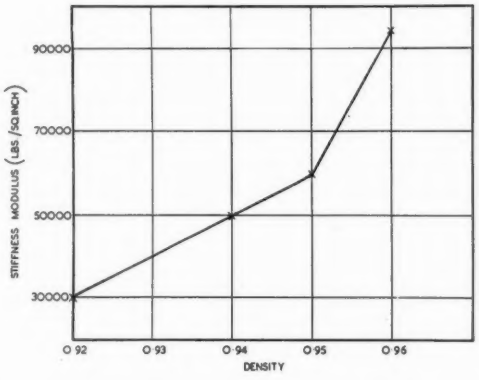
It will have been noted that the grade number, or melt index values, of the high density polythenes which are available are lower than those of the regular low density products. This is not fortuitous for experience has shown that if two products of the same melt index (or molecular weight) are made by the same process, the one with the higher density will be appreciably more brittle than the one with the lower density. This tendency is so pronounced that it must be corrected, by deliberately increasing the molecular weight (or by reducing the melt index).

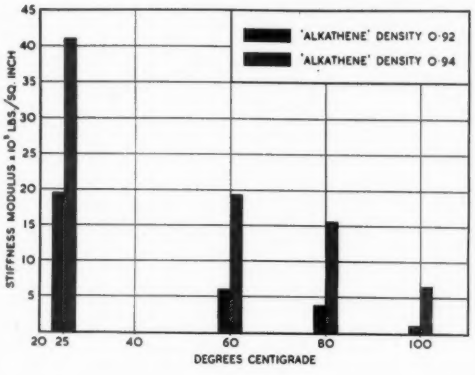
In concluding this section on properties, it may be said that the prospect of changing the density of polythene has given the chemist yet one more variable to work with. Hitherto a variation in molecular weight was the principal way of varying the properties and behaviour of polythene, but now a further range of effects can be produced.

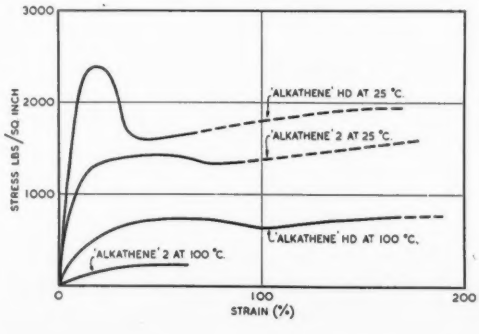
Processing Behaviour and Applications

Obviously, a product with a different crystalline structure, a different softening point and a different molecular weight requires a modified processing technique from that which has become standard for regular low density polythene, although experience has already shown that the necessary changes in technique are relatively minor. For example, in the case of extrusion most of the operations can be carried out with "Alkathene" HD at a temperature about 20° C. above the temperature normally









Left-hand column, top to bottom:—

Fig. 6. Effect of density on softening point.

Fig. 7. Effect of density on stiffness.

Fig. 7a. Effect of temperature on stiffness.

Fig. 8. Relationship between density and stress/strain characteristics.

Right-hand column, top to bottom:—

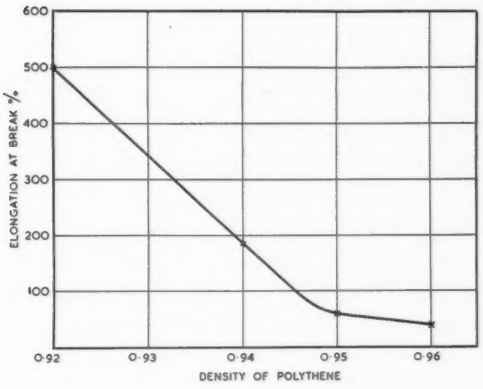
Fig. 9. Relationship between elongation at break and density.

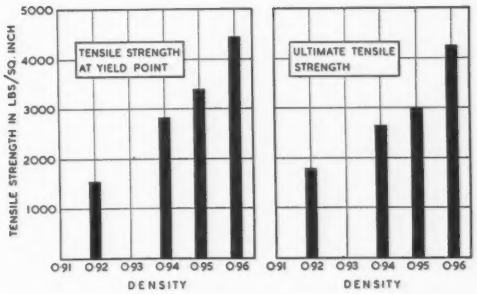
Fig. 10. Relationship between density and tensile properties.

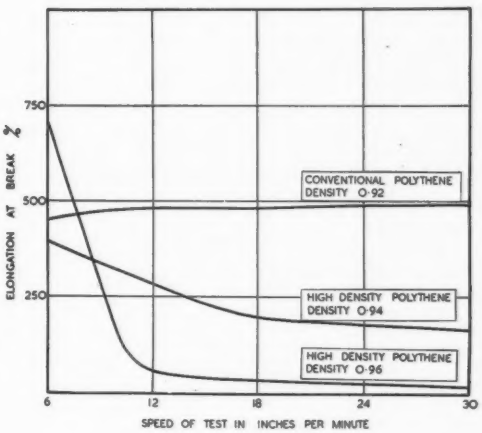
Fig. 11. Effect of speed of test on elongation at break.

Fig. 12. Variation of gas permeability with density.

Fig. 13. Variation of vapour permeability with density.






ELONGATION AT BREAK %
SPEED OF TEST IN INCHES PER MINUTE
CONVENTIONAL POLYTHENE DENSITY 0·92
HIGH DENSITY POLYTHENE DENSITY 0·94
HIGH DENSITY POLYTHENE DENSITY 0·96

GAS PERMEABILITY OF "ALKATHENE" (CC./CM./CM.²/SEC./CM. PARTIAL PRESSURE OF MERCURY)

Gas	" Alkathene " HD	" Alkathene " 2
Nitrogen	0.57×10^{-10}	1.1×10^{-10}
Hydrogen	5.3×10^{-10}	9.0×10^{-10}
Oxygen	1.7×10^{-10}	2.8×10^{-10}
Sulphur dioxide	21.0×10^{-10}	35.0×10^{-10}

(The above permeability values were obtained at 24° C. ± 1° C.)

WATER VAPOUR PERMEABILITY OF " ALKATHENE "

Material	Water vapour permeability gm./M²/day/thou.
" Alkathene " HD	7.4
" Alkathene " 2	16.6

(These measurements were made on 150 gauge (.0015 in.) film.)

FIG. 14. ABSORPTION OF ORGANIC LIQUIDS BY POLYTHENE

	Maximum Absorption %		Ultimate Tensile Strength, lb./sq. in.	
	" Alkathene " 2 Density 0.92	" Alkathene " HD Density 0.94	" Alkathene " 2 Density 0.92	" Alkathene " HD Density 0.94
Petroleum ether 110/120	30.5	10	895	2,160
Carbon tetrachloride	120	33	800	1,980
Benzene	36.5	13	870	2,030
Lubricating oil	15.3	5.9	1,300	2,550
Kerosene	26	8.3	1,000	2,360
Aviation spirit	30.5	9.7	1,100	2,300
Control	—	—	1,780	2,680

required for the most suitable low density extrusion grade.

This can well be illustrated by production tests carried out on a 3 in. Shaw extruder using a screw of the following type—found to be most suitable for low density polythene, i.e. a screw with a 15/1 length to diameter ratio, with a constant pitch decreasing depth section followed by a constant pitch constant depth metering section.

The accompanying diagram (Fig. 15) illustrates the temperature gradients for the two types of polythene.

When running under these conditions such a machine will produce about 110 lb./hr. of 2 in. bore tube with either type of polymer. One important difference is that the internal air pressure must be of the order of 8–10 lb./sq. in. compared with 2–3 lb. normally necessary in the case of " Alkathene " 2, i.e. the grade normally used for tube extrusion.

In the case of extrusion lamination on to paper we have so far not found it necessary to change the conditions in any way from those normally required with " Alkathene " 7. In this latter case it is always necessary to use very high die temperatures to get the melt in the correct physical condition to provide the correct degree of draw down, and the high density material appears to reach this condition at temperatures no higher than those necessary for the low density product.

In the case of the extrusion of film from high density polymer there are again no special difficulties although it is necessary to pay close attention to the draw ratio when making tubular or layflat film. Because of the high degree of crystallinity in the high density material there is a much greater tendency for orientation to occur and for the properties of the film not to be the same in all directions. For this reason when using high density or highly crystalline polythene it is advisable to use a higher blow ratio than with regular polythene. When this is done it is possible to produce film with better strength in both directions than is obtained with low density polythene.

Most of the troubles associated with the production of tubular film from low density polythene are associated with its tendency to " block," i.e. for the walls of the tube to stick together, but in the case of film from high density polymer this defect is completely absent both at high and low speeds and at relatively high and low temperatures.

The film of course, is quite different in character from that produced with low density polymer——it is less transparent, stiffer, more " paper-like " and less supple. It shows a greater tendency to shock brittleness but on the other hand its stiffness allows easy manipulation in existing packaging machines; it can be heat sealed in the normal way and, of course, it has a greater resistance to organic liquids and to the passage of gases.

Closely related to the question of polythene film is the question of polythene sheet suitable for the vacuum forming technique. This technique popularized mainly through the use of high impact styrene has now been applied to other materials and some success has been achieved with regular low density polythene, particularly by the drape forming technique. It seems from initial experiments that high density polythene will be still more attractive because in addition to its superior basic physical properties it is easier to manipulate. Furthermore, articles made in this way may be sterilized.

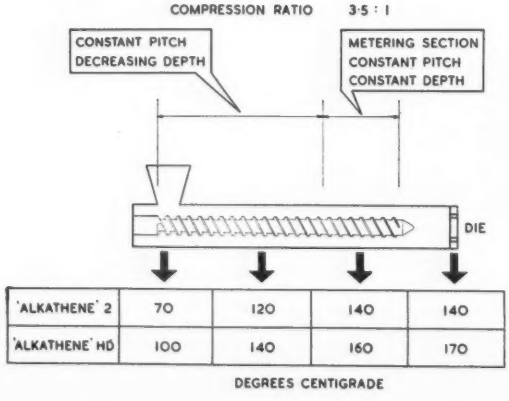

COMPRESSION RATIO 3·5 : 1
CONSTANT PITCH DECREASING DEPTH
METERING SECTION CONSTANT PITCH CONSTANT DEPTH
DIE
'ALKATHENE' 2 70 120 140 140
'ALKATHENE' HD 100 140 160 170
DEGREES CENTIGRADE

Fig. 15 (Left). Temperature gradients for two types of polythene, " Alkathene " 2, and " Alkathene " H.D. The screw used here has a 15/1 length to diameter ratio.

These general remarks on extrusion are very relevant to the possible use of high density polythene for wire covering and cable applications. Using " Alkathene " HD it is possible, at least for thin coatings up to about 4 mm. to cover wire at a speed of about 14,000 metres/hr. which is quite normal for " Alkathene " 2 the most popular grade in Gt. Britain for cable applications.

Cables of all types represent one of the most important applications for polythene, and in Gt. Britain it is, in spite of the growth of film the largest application of all. One of the most popular of such applications is the telephone distribution cable which normally employs an insulation having a radial thickness of about 4 mm. In such applications it is the mechanical requirements of the job rather than the electrical requirements which determine the insulation thickness, and obviously commercial considerations dictate that the thickness be the minimum comparable with good performance. But mechanical damage during " twinning " or assembly of the composite cable is one of the hazards, and it is believed that the use of high density polythene may allow a reduction in wall thickness and still give sufficient protection against cutting and abrasion. Satisfactory trials have already been carried out with insulations of 3 mm., and tests are now being carried out with coverings as thin as 2 mm. Obviously this would not only allow a smaller or less bulky cable to be made but would offer prospects of a cheaper cable provided of course, that the two types of polythene were available at the same price.

Similar considerations hold in the case of cables with thicker insulations such as those used for high frequency industrial signalling, and house wiring applications, except that it is undoubtedly more difficult to extrude void free insulations and special graduated cooling methods have to be adopted. The general adoption of high density polythene for these types of cable applications is not expected to be rapid, for cable production more than any other plastic development is controlled by rigid specifications and it will be necessary to carry out prolonged field trials. Sufficient is known about the product, however, to suggest attractive possibilities.

There may, however, be a more immediate attraction in the use of high density polythene for power cables. Here thickness of insulation, in contrast to the situation for other cable types, is controlled largely by the electrical requirements for the actual breakdown voltage of a cable is always very much below what one would expect from the intrinsic breakdown voltage of the polythene as measured on test specimens. For this reason unusually heavy insulation layers are used and it is not likely that the use of high density polythene will lead to any saving in that respect.

On the other hand, the superior temperature characteristics of high density polythene offer very definite prospects in this field which has developed relatively slowly with low density polythene and it should be possible to run power cables at higher ambient temperatures. This permits the carrying of heavier loads, which automatically means a cheaper cable or cheaper power distribution. Furthermore, the better mechanical strength of high density polymer at high temperatures should allow cables to be operated under heavy overloads, or peak loads, without the danger of decentralization of the conductor.

Another cable possibility opened up by the advent of high density polythene is the composite polythene/neoprene cable—the latter having outstanding attractions as a cable sheath because of its toughness, its abrasion resistance, its resistance to fire and its resistance to weathering. So far it has not been possible satisfactorily to vulcanize a neoprene sheath on to a polythene dielectric, but the availability of high density polythene with its higher softening point suggests a possible means of overcoming this difficulty.

Perhaps the most interesting speculation about the future of high density polythene occurs in the case of tube or pipe—now one of the major uses for regular low density material, as probably 10% of all polythene now made is used in pipe production.

The attractions of high density pipe are that it is stronger and tougher and will stand higher temperatures, but on the other hand it is more rigid and consequently more difficult to coil. There are two approaches to the problem; firstly, to retain existing dimensions and standards and thereby permit higher working pressures (or greater margins of safety), or secondly, to reduce wall thickness and thereby lower the cost. In the latter case, however, there is a danger if screw fittings are to be used, because there must be sufficient wall thickness initially to permit the threading operation.

In the United Kingdom polythene pipe is generally made from " Alkathene " 2 and the dimensions and use are strictly controlled by B.S. 1972 and a corresponding code of practice.

Permitted working pressures are very much below actual bursting pressures as for example, in the case of $\frac{3}{4}$ in. tube which has a bursting pressure of about 450 lb./sq. in., although it is not allowed to be used at working pressures above 150 lb./sq. in. Calculation and practical trial confirms that pipe made from " Alkathene " HD can be used at approximately double the pressures as it has a bursting strength of about 930 lb./sq. in.

This is an obvious attraction for those water authorities which have to run at higher working pressures or where there are abnormally high peak pressures.

Another way of looking at the problem is to reduce the wall thickness by 40–50% to permit the same working pressure as for low density material and thereby save polymer.

One important disadvantage of tube made from high density polythene is its stiffness, and except in small bore tube it will be most difficult to coil and must be used in straight lengths—say 20 ft. with a corresponding necessity for more joints. Coiled pipe can, of course, be produced but it will be necessary for the coils to be bigger and they will have greater induced strain than smaller coils of low density type.

The other important aspect of polythene pipe production from high density polymer is —can it be used for carrying hot water? In spite of the fact that low density polythene melts at 110–115° C. it is not really suitable for hot water mainly because of its loss of strength as the temperature rises, with the result that safe operating limits become very low. If high density polythene pipe is used it will, of course, have a much higher margin of safety on strength considerations firstly, because of its higher intrinsic strength and because of its higher softening point. On the other hand, it will suffer from the same thermal expansion and oxidation influences as regular low density polythene, and judgment on the whole issue must be postponed until extensive practical trials have been carried out.

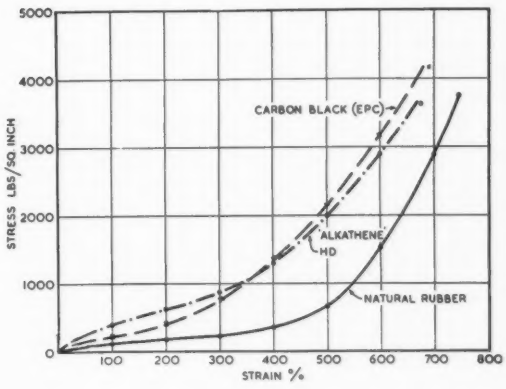


Fig. 16. This graph shows clearly the effect of HD polythene as a reinforcing agent for rubber. Comparison is made with carbon black.

Turning next to the field of injection moulding we have to consider high density polythene against a background where this is an application which in Gt. Britain is second only to cable applications, and if present trends continue it could soon be the greatest. As in other fields, its main attractions are in virtue of its high softening point and its high rigidity or stiffness which mean that it is now possible to mould articles such as the domestic washing-up bowl or hospital utensils which stand not only hot water but steam sterilization also.

In other words, high density polymer will help to create new outlets for polythene rather than to displace existing ones, although there will undoubtedly be some attraction in the harder surface and absence of wax-like surface which the high density material provides.

Another angle to the moulding application is the possibility of a saving in cost by reducing the wall thickness of polythene articles such as the domestic washing-up bowl. So far the economics of this job have not been established and they cannot be so long as the exact long term price of high density polythene is unknown.

As far as the moulding operation itself is concerned, there are no special difficulties apart from the necessity of using higher temperatures with the high density polymer. The object of any moulding operation is to produce the highest number of articles per hour at an acceptable standard of finish and general mechanical performance. Generally speaking the output from any given polymer is controlled by the cooling cycle which becomes shorter as the moulding temperature becomes lower, but because higher moulding temperatures give a better surface finish a compromise must always be reached. In the case of high density polythene higher cylinder temperatures are necessary, but on the other hand the material can be extracted from the mould at higher temperatures, so the two factors tend to balance out. As a result it may be claimed that the rate of production of injection moulded articles from high density polymer is not very different from that of regular low density material. In the case of " Alkathene " HD it is necessary to use a cylinder temperature of about 320° C. compared with 280° C. for " Alkathene " 2, and although slightly higher injection pressures are necessary there is, of course, no special difficulty because of the great ease with which polythene generally may be processed.

An entirely new potential application for high density polythene is for the reinforcement of rubber. As long ago as 1940 mixtures of natural rubber and polythene (low density) were used for a particular application and they were particularly attractive for certain calendering jobs. Prosecution of this type of work was allowed to lapse and only now with the discovery of high density polythene is it being reopened. The surprising fact is that high density polythene is a very interesting reinforcing agent for rubber—not, of course, in the same category as carbon black, but one which provides reinforcement without loss of the normally excellent resilience characteristics of natural rubber.

The full implications of this observation are not yet understood, but the graph shown in Fig. 16, will indicate the general effect.

Book Reviews

Commercial Waxes.

By H. Bennett. 688 *pages.*
Chemical Publishing Co., Inc. 15 *dollars.*

The first edition of this book created great interest in view of the comprehensive treatment covering properties, technology of manufacture, industrial applications and formulations.

The second edition, just published, is a substantially enlarged version which has been much supplemented by the incorporation of over 160 tables and some 60 graphs.

Engineering Inspection Manual.

By H. A. Roy. 160 *pages.*
Chemical Publishing Co., Inc. 5 *dollars* 75 *cents.*

Although based on American procedure, this handbook will be of considerable interest to A.I.D. inspectors and others engaged in machine tool, aircraft and other mechanical inspection.

The Use of P.V.C. Pastes in Offset Lithography

By A. E. Jackson * and A. Blake,* B.Sc., A.P.I.

THE preparation of offset plates bearing a photographically obtained image is usually carried out by exposing a negative to a light sensitive planographic plate which, after exposure and processing, yields a greasy ink receptive surface in the image areas. The sensitive layer is made ink receptive by exposure to light. A typical layer is the well-known bichromated albumen coating where the action of light renders the layer insoluble and ink receptive.

Other light sensitive coatings comprise the more recently developed diazo dye layers used in pre-sensitized plates. Exposure to light through a negative produces an oleophilic image in the light-struck areas. The above are only two of several methods in existence for the preparation of offset plates other examples being plates prepared by Xerography, electronic scanning and transfer processes. In every case, a positive image of the original capable of taking up ink is formed on a planographic plate.

A novel method of producing an offset plate consists in applying to the surface of a paper plate, a specially compounded p.v.c. paste via a photographic stencil. After the paper plate has received its image in this manner, it is heated at a fairly high temperature for a short while in order to gelate the p.v.c. thus obtaining a non-smudging ink-receptive image.

Whereas the methods described in the introduction will yield one plate per exposure, the stencil/p.v.c. paste method is capable of giving any required number of plates by means of passing the ink through the stencil apertures. Thus, for one photographic operation (the preparation of the photo-stencil) any number of offset plates may be obtained—the stencil being in effect, a mechanical negative.

A convenient method of producing a photographic stencil is by means of the Gestetner Photoscope process which produces a negative stencil direct from an original in the matter of a few minutes. The operation of this process consists in placing an original in a specially designed stencil camera known as the Photoscope employing a process lens.

In the image plane, the light sensitive stencil material is exposed to the image of the illuminated original and the latent image subsequently developed in a tanning developer which hardens the coating in the light struck areas. The unaltered non-light-struck coating is afterwards washed away in warm water yielding a stencil which after drying in a special fluid is ready for duplicating on an office machine.

A photographic stencil consists essentially of a long fibred open tissue which is impregnated with a silver halide emulsion. It will be appreciated that it is the fibrous open structure matrix of the tissue which supports the hardened portions of the stencil at the same time allowing the ink to pass freely on to the impression papers.

The p.v.c. paste which has been compounded for the production of offset plates is of a similar consistency to that of inks which are normally used for obtaining copies from photographic stencils. Furthermore, a machine and stencil may be left "inked up" with the p.v.c. paste without fear of drying or clogging.

A typical formulation for such a paste consists of:—

P.V.C.	140 grams
Tritotyl phosphate ..	150 grams
Nigrosine Waxoline ..	5 grams
Filler	5 grams
White Lead	7 grams

The most suitable paste forming polymer was found to be Corvic P65/47 manufactured by I.C.I., Ltd. It was found advantageous to sieve the powder using the fraction which passed through a 240 mesh sieve. The filler is one which gives the desired degree of rigidity without necessitating a heavy loading. Without this filler it was found that the shelf life of the compounded paste was very limited. It is believed that this was due to the progressive swelling of the polymer by the plasticizer, leading to a fairly large viscosity increase. The addition of the filler (in the quantity stated) overcame this trouble and gave a paste with a very long shelf life. It was found necessary to roll mill the paste at least three times before a perfectly smooth long storage ink was produced.

The Nigrosine was dissolved in the t.t.p. at 80° C. and cooled before addition of the p.v.c., filler and stabilizer. Many stabilizers could be used but White Lead was selected because of its efficacy. The selection of the plasticizer was not obvious as we wished to obtain one with (*a*) high boiling point (for good ageing), (*b*) low rate of change of viscosity with temperature (to keep required ink consistency constant), (*c*) high viscosity (to minimize migration into stencil). As is usual a compromise had to be made and after fairly exhaustive tests t.t.p. gave us good all round properties.

Having described separately the nature of the various materials used, the process as a whole is now described briefly, step by step.

The original is placed in the Photoscope and the stencil in the image plane is exposed, developed in the tanning developer for 2½ mins. at 18° C. and washed out in hot water. The stencil is then placed in a special fluid for a few minutes, blotted to remove excess fluid and used as a mechanical negative for the production of offset plates.

An office duplicator may be inked up with the special p.v.c. paste and the required number of plates run off. The plate bearing the inked image is now heated to a temperature of 120–160° C. for about 30–60 secs. in order to bring about the necessary gelling of the paste, and the plate, without further treatment can be used on an offset machine.

The authors would like to express their thanks to the Directors of Gestetner, Ltd., for permission to publish this article.

* Gestetner Ltd.

A Polyurethane Prepolymer for Hydrophilic Foams

A POLYURETHANE prepolymer recently developed will produce foams with outstanding water absorption and high strength. Foams prepared from this prepolymer are resilient and are reported to have unequalled water pick-up compared to the conventional polyurethane foams. Typical water absorbency values are in the range of 1,200% by weight. These properties are naturally of particular interest for the domestic and industrial sponge manufacturer.

The prepolymer, which is manufactured by the Thiokol Chemical Corporation, Trenton, New Jersey, and named ZL-239, is available as a three-package mix which can easily be processed into foam with simple equipment. Variations in density can be achieved with minor adjustments in water content. The following typical physical properties are available: viscosity at 80° F., 60 poises; specific gravity at 25° C., 1.200; and colour, amber.

In the preparation of a hydrophilic polyurethane foam, the best results are obtained by adding the emulsifier mix to the ZL-239 and blending until uniform. The catalyst mix is added at approximately 27° C. and stirred vigorously until foaming is about to begin. The mixture is then poured into waxed moulds and allowed to cure for 30 minutes at room temperature and one hour at 70° C.

In a formulation No. R402–1 quoted by the company, using 3 parts by weight of emulsifier, 112 parts of ZL-239, and 7.4 parts of catalyst mix, a sponge of uniform cell structure, soft texture, and good water pick-up is obtained. Variations in density can be obtained by adding an additional 0.1 to 1.0 parts of water to the catalyst mix. The physical properties of the foam obtained are as follows:—

Tensile strength ..	dry, 22 p.s.i.
	wet, 11 p.s.i.
Elongation	dry, 300%
	wet, 175%
Water absorbency ..	1,200%
Density	4.5 lb./cu. ft.

It is recommended that the new prepolymer should be stored above 65° F. and if the material is stored below 65° F. the container should be heated before using. Under ambient conditions, the prepolymer has not changed in viscosity or foaming performance after three months.

No toxicity tests have been made so far but since the ZL-239 contains some free diisocyanate, normal precautions for handling diisocyanates are recommended.

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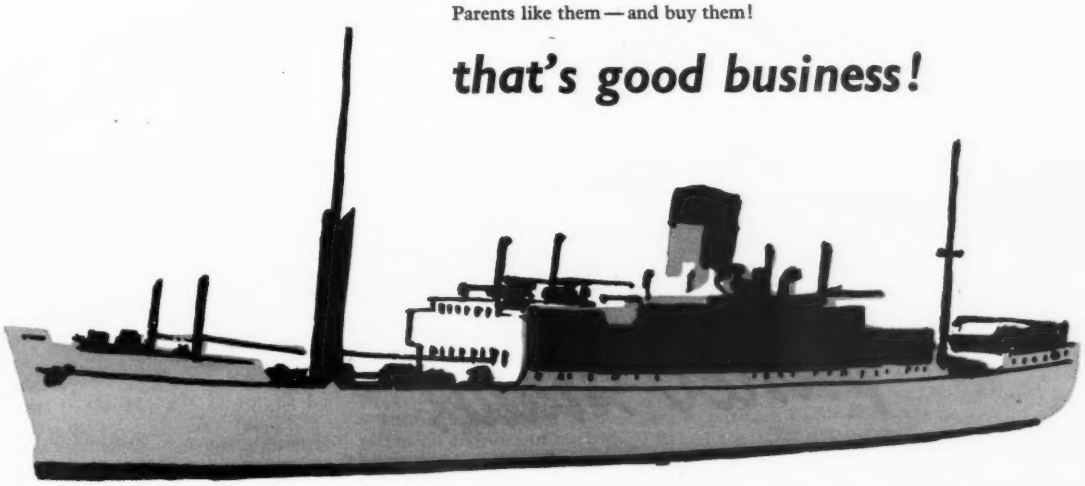

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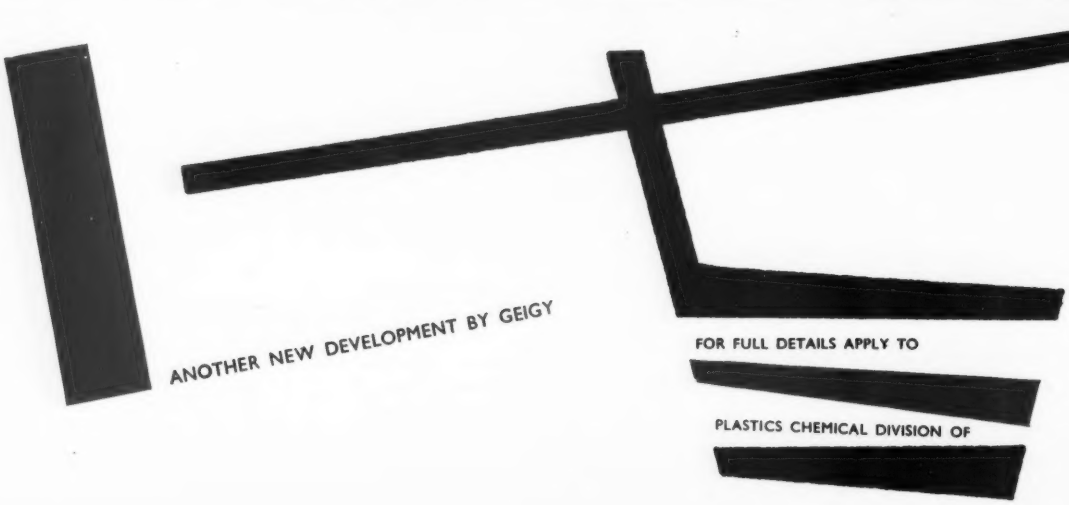

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P37

The Properties and Testing of Plastics Materials—Part 9

Industrial Materials—Special Tests, Properties etc., Cellulose Acetate, Cellulose Acetate Butyrate, Cellulose Nitrate.

By A. E. LEVER,* A.I.R.I., and J. RHYS,† M.Sc.

Section 1. Cellulose Acetate

IN the British Specification (1) the form of qualifying clauses has been adopted from (2). Little confidence can be placed in the results on a small number of specimens, when each result is considered on its own.

The Specification covers acetic acid esters of cellulose, but not mixed esters, and includes moulding materials with plasticizers and minor proportions of other ingredients.

Classification is on a basis of softening point, which should not be confused with flow-grading tests or moulding temperatures.

	Grade.	Softening Point ° C.
Very soft	SS	45–56
Soft	S	45–56
Medium soft	MS	45–56
Medium	M	57–65
Medium hard ..	MH	57–65
Hard	H	Over 65
Very hard	HH	Over 65

Basic values are given for properties of primary importance in the control of quality:—

	Soft.	Medium.	Hard.
Tensile strength psi.	2,700·0	3,500·0	4,500·0
Moisture absorption % ..	3·0	3·5	3·5
Moisture content at time of despatch % ..	1·6	1·6	1·6
Leaching % ..	5·0	3·0	2·5

Condition is at 75% RH at 25° C. for 48 hours.

Although the moisture content is given as 1·6%, or less, this does not mean that the moulding powder is necessarily suitable for injection moulding without pre-drying.

The latest American Specification (3) for moulding powders covers three types and 13 grades, classified according to their flow properties. This Specification differs in many details from the 1948 tentative specification.

Some of the detailed requirements for moulded test specimens are given in Table 1.

Cellulose acetate sheets are covered in specification (11). There are two types for general purposes and aircraft.

A.S.T.M. methods of testing were used (4) to show the effect of temperature and humidity on the mechanical properties of cellulose acetate injection moulded specimens, and the author comes to the following conclusions:—

(*a*) The yield stress, breaking strength and modulus of elasticity increases as the temperature is reduced, and vice versa.

(*b*) The degree of plastization influences the strength at any temperature, but not the shape of the temperature-strength, or temperature-modulus curves.

(*c*) Elongation at break decreases as the temperature is lowered, and vice versa. Plasticizers have a considerable influence.

(*d*) Impact strength is greatly influenced by temperature changes.

(*e*) Moisture acts as an efficient plasticizer.

(*f*) Yield stress, breaking strength and modulus of elasticity are increased, and elongation decreased by reduction in humidity, and vice versa.

(*g*) As the plasticizer content is increased, moisture absorption at any RH level is decreased. Phosphate esters in the plasticizer formulation tend to decrease moisture slightly, especially at high humidities.

Tables are given (5) showing varying properties of different grades of cellulose acetate, but the figures differ from those published in the most recent Specification (3).

There are some useful tables of various properties (6) and various methods of testing are briefly noted. A list of trade names is appended. General notes and data are also given (7).

Methods for the analysis of cellulose esters are given (8) as well as a comparison of cellulose acetate and cellulose acetate butyrate under varying conditions of temperature and humidity (10).

There is a comprehensive table of properties (9).

Analytical methods specifically relating to cellulose acetate are:—

Acetyl Value (6). Most methods in standard use are saponification methods, although distillation methods have been developed which are claimed to give more accurate results. Several methods are given.

Acidity (6). Two methods are given.

In discussing the influence of the speed of testing the strength of cellulose acetate it was demonstrated (12) that the yield point and fracture stress increased with increasing rate of strain for tests in tension, compression and torsion.

Typical Properties (13), (14)

S.g.	1·24–1·32
Specific volume, in.³/lb.. ..	21·0–22·5
Impact strength (Izod), ft. lb./in. at:—	
−40° F.	0·3–0·9
+ 73·4° F.	0·5–4·8
Tensile strength, p.s.i. at 73·4° F.	2,250–11,000
Water absorption, % at 24 hrs..	2·1–4·0
Soluble matter loss, % at 24 hrs.	0·1–2·4
Weight loss, % 72 hrs./180° F..	0·1–11·5
Hardness, Rockwell (R).. ..	35–118
Volume resistivity, 50% RH, ohm./cm.	10^{10}–10^{12}
Dielectric strength, 50% RH, 60 c/s, v/mil.	290–600
Dielectric constant, 50% RH, 10^6 c/s	3·2–7·0
Power factor, 50% RH, 10^6 c/s..	0·01–0·10
Distortion under heat, ° F. at:—	
264 p.s.i.	111–195
66 p.s.i.	120–209
Shrinkage in./in.), 40% RH/75° F., for 12 months	0·010–0·015
Thermal conductivity, c.g.s. $\times 10^{-4}$	4–8
Thermal expansion, in./in./° C., $\times 10^{-5}$	8–16
Flow temperature, ° F.	257–347
Moulding temperature, ° F.—	
Injection	335–450
Compression	260–420
Extrusion	335–450
Mould shrinkage, in./in.—	
Compression:	
Positive	0·002–0·003
Semi-positive	0·005–0·007
Flexural strength at yield, p.s.i. $\times 10^3$	2·2–11·5
Compression strength at yield, p.s.i. $\times 10^3$	2·2–10·9
Mod. of elasticity, p.s.i. $\times 10^5$..	0·65–2·60
Refractive index, n_d	1·46–1·50
Specific heat, cal./gm./° C. ..	0·30–0·42
Acids	Affected
Alkalis	Affected
Soluble	Ketones, esters

TABLE I

Type	Medium				Hard			Soft	
Designation	MH1	MH2	MS1	MS2	HO1	H41	H21	S21	S22
Flow temperature °C.	150	150	140	140	180	170	160	130	130
Tensile strength, min. psi.									
at 23° C. ...	3800	3600	3000	2700	5600	5400	4600	2400	1900
at 70 °C. ...	1900	1600	1300	1100	4000	3000	2300	900	800
Heat distortion temp. min. °C.	54	52	48	47	80	73	62	45	44
Impact strength (Izod) ft. lb./in. at 23 °C.	1·1	1·7	1·4	2·4	0·4	0·6	0·8	2·0	3·5
Water absorption, max. % ...	5·5	4·4	5·7	5·0	3·5	3·6	5·3	6·5	5·7
Weight loss on heating 72 hours at 82° C., max. %	6·0	5·8	7·5	8·8	0·8	2·0	5·0	11·5	12·0

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*Consultant †F. W. Berk and Co. Ltd.

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Section 2. Cellulose Acetate Butyrate

MOULDING compounds are graded in a manner similar to cellulose acetate (1) and the tests are similar.

The method of estimating the acetyl and butyral content is given (2), and a full scheme of analysis, with comprehensive tables of properties in (3).

Typical Properties (4), (5)

S.g., 20° C.	1·15–1·30
Density, oz./in.³	0·67–0·71
Specific volume, in.³/lb.	21·8–23·9
Compression ratio	2·0–2·5
Tensile strength, p.s.i. 73·5° F. × 10³	2·6–7·0
Elongation at break %	40–88
Impact strength (Izod), ft. lb./in. at—	
— 40° F.	0·4–1·7
+ 73·4° F.	0·8–6·3
Flexural strength at yield, p.s.i.	1,800–9,250
Compressive strength at yield, p.s.i.	2,100–9,400
Mod. of elasticity (Flexure), p.s.i. × 10⁵	0·55–1·85
Water absorption, % at 24 hrs.	0·9–2·3
Soluble matter lost, % at 24 hrs.	0·1–0·2
Refractive index, n_d	1·46–1·49
Hardness, Rockwell R	31–116
Specific Heat, cal./g./° C.	0·3–0·4
Distortion under heat, ° F.—	
264 p.s.i. load	113–202
66 p.s.i. load	130–227
Weight loss, %—72 hrs. at 180° F.	0·1–3·2
Thermal conductivity, c.g.s. × 10⁻⁴	4–8
Thermal expansion, ° C., in./in. × 10⁻⁵	11–17
Flow temperature, ° F.	257–347
Moulding Temperature, ° F.—	
Injection	335–450
Compression	265–390
Extrusion	335–450
Mould shrinkage, in./in.—	
Injection	0·002–3
Compression:	
Positive	0·002–3
Semi-positive	0·005–7
Volume resistivity, 50% RH, ohm./cm.	10^{10}–10^{12}
Dielectric strength, 50% RH, v./mil.	250–400
Dielectric constant, 50% RH, 10^6 c/s	3·2–6·2
Power factor, 50% RH, 10^6, c/s	0·01–0·04
Acids	Affected
Alkalis	Affected
Soluble	Ketones, esters

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2. A.S.T.M. Spec., D.817–55T.
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4. Tenite Specifications, 6th Edn., 1953.
5. Ethyl Cellulose—Hercules Co., 1949.

Section 3. Cellulose Nitrate

THE A.S.T.M. Specification (1) divides cellulose nitrate into four types:—

(1) General purpose transparent.
(2) Improved toughness—transparent.
(3) General purposes—pigmented.
(4) As type 3 but improved toughness.

These are sub-divided into four grades of different thicknesses. The following properties are enumerated for sheets 0·060 in. to 0·125 in. thick:—

Type	1	2	3	4
S.g.	1·35	1·35	1·35	1·35
Tensile strength, p.s.i.	6000	4000	4500	5000
Impact strength (Izod), ft. lb./in. at—				
25° C.	3·0	4·0	1·0	2·0
— 40° C.	0·75	1·0	0·25	0·50
Water absorption, % at 24 hrs.	2·5	3·0	2·5	3·0

Methods of testing are given, and apart from the usual tests the following are added:—

(*a*) **Residual volatile matter.** This shall be such that the material will not warp or buckle excessively on ageing under normal room conditions. The sample is heated in a vacuum oven and the loss of weight determined. It does not measure the absolute value of the volatile constituents, and provides relative data only.

(*b*) **Fuming off temperature,** in which the sample is heated, under controlled conditions, until it decomposes explosively. This is recorded as the "fuming off" temperature. It shall not be less than 165° C.

(*c*) **Free acid** shall not exceed 15 e.p.m. (equivalent parts per million), which expresses acidity, or alkalinity, in terms of acidic hydrogen concentration in p.p.m. Methyl red is used as the indicator.

A general theory of the adhesion of high polymers to cellulose is presented (6), the tests being made with cellophane. An inverse measure of the potential adaptability of a polymer to an interface, is the "tack temperature," which is the lowest temperature at which two coated cellophane films will just fuse, i.e. heat seal, at a pressure of 20 p.s.i. applied for 2 seconds. The lower the tack temperature the higher the fluidity of the polymer.

There is a curvilinear relationship between stress and strain which increases with increasing rate of strain (7).

Determination of the viscosity of cellulose nitrate in the British, American and German systems is given (8). There is also a number of useful tables of tensile strength with different plasticizers, grades, solvents, etc.

Typical Properties of Cellulose Nitrate Plastics (2)

S.g.	1·39
Tensile strength, p.s.i.	5,600
Elongation at break, %	42
Impact strength (Charpy), ft. lb./in.—	
— 20° F.	0·75
+ 77° F.	4·33
Compressive strength, p.s.i.	14,200
Modulus of elasticity, p.s.i.	308,000
Flexural strength, p.s.i.	7,800
Water absorption, %	0·97
Volume resistivity, 50% RH, ohm/cm.	10^{10}
Dielectric strength, v./mil.	600–1,200
Thermal conduct, c.g.s. × 10⁻⁴	3·1–5·1
Specific heat, cal./g./° C.	0·33–0·38
Thermal expansion, inc. per unit length × 10⁻⁵/° C.	12–16

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1. A.S.T.M. Spec., D.701–40.
2. Nitro-Cellulose—Hercules Co., 1952.
3. A.S.T.M. Spec., D.785–51.
4. A.S.T.M. Spec., D.256–43T.
5. A.S.T.M. Spec., D.638–52T.
6. *Mod. Plast.*, 1954, **31**, No. 11, 115.
7. *Trans. A. S. Mech. Eng.*, 1945, **67**, 23.
8. *J.O.C.C.A.*, 1954, **37**, No. 404, 63.

Properties—Range of Industrial Cellulose Nitrates (8)

(*a*) **Fibrous type from cotton linters**

Type	*British Symbol*	*Nitrogen %*	*g.Nc/100 cc. solvent*	*Viscosity c.g.s. 20° C.*
High Nitrogen				
Extra low viscosity	HX 3/5	11·8–12·2	40	3–5
	HX 8/13		40	8–13
	HX/30/50		40	30–50
Low viscosity	HL 30/40		20	30–40
	HL 120/170		20	120–170
Medium viscosity	HM 15/20		10	15–20
High viscosity	HH 9/20		3	9–20
Low Nitrogen				
Extra low viscosity	LX 20/40	10·5–11·2	40	20–40
Low viscosity	LL 45/65		20	45–65
Medium viscosity	LM 15/35	10·7–11·2	10	15–35

(*b*) **"Dense" type from woodpulp**

High Nitrogen				
Extra low viscosity	DHX 3/7	11·5–12·0	40	3–7
	DHX 8/15		40	8–15
	DHX 20/60	11·6–12·0	40	20–60
Low viscosity	DHL 20/60	11·6–12·2	20	20–60
	DHL 100/200		20	100–200
Medium viscosity	DHM 10/25		10	10–25
Medium Nitrogen				
Extra low viscosity	DMX 20/60	11·2–11·8	40	20–60
Low viscosity	DML 100/200		20	100–200
Medium viscosity	DMM 5/15		10	5–15
Low Nitrogen				
Extra low viscosity	DLX 20/60	10·7–11·2	40	20–60
Low viscosity	DLL 40/70		20	40–70

Patent Review

The following abstracts have been made from specifications at the Patent Office, with the permission of the controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 0d. each (including postage).

B.P. 756,093. Collapsible containers. To: Flexipac, Ltd.

A plastic perforated tube is inserted in the collapsible (plastic) tubular body for feeding ink to duplicating machines. The ink is drawn through the tube to the orifice eliminating the previously experienced drawback of irregular flow.

B.P. 756,138. Stabilizing alkenyl aromatic resins against weathering. To: Dow Chemical Co. (U.S.A.).

Tetramethyldiamino-2-propanol is an effective agent for retarding or preventing impairment of strength and other mechanical properties and also discoloration upon exposure to light. 0.05 to 5% of the agent should be added to the moulding composition.

B.P. 756,170. Laminated transparent structure adopted to function as a safety closure rupturable under shock. J. H. Shorts. To: Pittsburgh Plate Glass Co.

Laminated glass or plastic is employed as window elements. An interlayer of plastic material extends beyond the edges of the outside plates and is mounted between frame members. The plates are scored to break under shock (explosion) along certain lines so that the parts swing outward without falling to pieces and can be put back and stuck together again as a window.

B.P. 756,179. Dies. W. Tompkins & Son, Ltd., A. G. Grimwade.

A template made of a phenol-formaldehyde or urea formaldehyde laminate (e.g. "Tufnol") is provided with holes into which metal perforators are inserted for marking out and cutting leather, plastic or analogous sheet material.

B.P. 756,224. Portable electric light unit. G. E. Finch, R. H. Frankland.

In a translucent shock-resisting casing of methyl methacrylate or a vinyl resin, one part red, the other one clear, white or amber.

B.P. 756,239. Hulls of boats formed from synthetic resin-bonded glass fibre. Watercraft Ltd., A. G. W. Hall.

A resin bonded glass fibre boat hull formed in a number of parts on either side of a keel plate. For small boats, only two parts are needed. This design avoids the difficulty of moulding a single boat hull.

B.P. 756,245. Electric lighting lanterns, more particularly for street lighting. To: General Electric Co. (U.S.A.).

Arrangement to eliminate difficulties through differential lengthwise expansion of hood (aluminium) and translucent member (plastics or glass) at different temperatures.

B.P. 756,270. Accordion-pleated type screen for heat-insulating purposes. E. U. Janson (Sweden).

Of flexible, e.g. plastic material folded in the form of an H.

B.P. 756,316. Illuminated halos for statues. F. McGuirk (Irish Republic).

A flat ring of, e.g. methyl methacrylate ("Perspex") illumination being applied edgeon by a suitably mounted electric lamp.

B.P. 756,317/18. Electric lighting lanterns more particularly for street lighting. To: General Electric Co. (U.S.A.) div. out of 756,245.

B.P. 756,329. Moulding of thermo-setting resinous compositions under heat and pressure. V. E. Yarsley, B. Frenkel. To: Bartrev Ltd.

Wall or other boarding is made of wood chips and a thermosetting binder (urea, melamine or thiourea formaldehyde resin) with a citrate hardener in the form of a mat laid on a conveyor. The mat is heated, then placed under pressure under continuous temperature control.

B.P. 756,342. Anatomical models. G. Blaine.

Anatomical model for demonstrating female pelvic cavity making at least part of cavity and birth channel transparent and slightly flexible. Use of transparent plastics is suggested.

B.P. 756,351. Manufacturing hardenable stable aminoplasts. To: Rutgerswerke A.G. (Germany).

B.P. 756,383. Marbled thermoplastic sheet materials and marbled rubber-composition sheet materials. L. H. Griffith. To: Semtex Ltd.

Predictable marbling patterns are produced by superimposing a net of thermoplastic material on a base sheet of thermoplastic material of a different colour and calendering the assembly in plastic state.

B.P. 756,447. Apparatus and method for cutting thermoplastic materials. General Electric Co. Ltd., T. R. Leng.

A heated strip of metal is pressed with its edge into the sheet of plastics (methyl methacrylate) along the line of the cut to be made. The strip penetrates the material when its temperature exceeds the softening point of the plastics.

B.P. 756,453. Footwear. D. M. Callow, J. Bearn. To: D. M. Callow.

An outer sole of grid or lattice form made of nylon or polythene.

B.P. 756,456. Conical bottle caps. H. Majer. (Germany).

Caps to be placed one inside the other for transport and storage with deformations to keep caps apart for facilitating separation.

B.P. 756,491. Electric cables. R. C. Milner, D. F. A. Austin. To: Enfield Cables Ltd.

Self-coiling cable with separately insulated conductors the insulation being extruded nylon.

B.P. 756,492. Containers for corpses. H. Lehner (Austria).

Formed from synthetic plastic sheet material (coloured and glass clear polyvinyl chloride welded together) with an opening closed by a gas and fluid tight slide fastener.

B.P. 756,555. Production of foamed plastic material. A. Cooper, F. Franks. To: Expando Rubber Co. Ltd.

A support is provided for the polymer foam during the processing to prevent collapse.

B.P. 756,556. Pencil holder. E. Lowenstern. To: Lobros Ltd.

A holed plastic disc on a suction cup to be fixed e.g. to a telephone.

B.P. 756,745. Moulding fibrous material. J. Rees, K. E. Preece. To: Bristol Aeroplane Co. Ltd.

In order to orient the fibres, a fluid mixture of fibres and bond is caused to flow through the mould from an inlet to an outlet for a certain period before closing inlet and outlet to allow that part of the mixture then contained in the mould to set.

B.P. 756,786. Mixtures of plastics and shaped articles made from such mixtures. To: Badische Anilin- & Soda-Fabrik A. G. (Germany).

Articles from mixtures of major proportions of polystyrene and a copolymer of di-normal-butyl fumarate and butadiene show high impact strength.

B.P. 756,792. Baby soothers. R. Natonek (Italy).

B.P. 756,797. Aerofoils and methods of manufacturing same. To: Soc. Nationale de Construction Aéronautiques du Sud-Est (France).

A tubular (steel) spar of progressively decreasing thickness towards the tip is provided with a multiplicity of metal protected single or composite hollow elements of streamlined shape, made of thin moulded plastic material reinforced with glass fabric, e.g., for a helicopter blade.

B.P. 756,814. Coating polytetrafluoroethylene. M. W. Croze, P. L. Hedrik. To: Minnesota Mining and Manufacturing Co.

A thin metallic coating is deposited under vacuum on the unsintered material, then the polytetrafluoroethylene is sintered without fusing or oxidising the coating. For electrical apparatus (cables, coils, capacitors).

B.P. 756,851. Production of moisture proof sheet wrapping materials. W. Berry, W. G. Harland. To: British Cellophane Ltd.

A solid film of regenerated cellulose is coated with an aqueous dispersion of a polyvinylidene halide by using pairs of applicator rolls. Doctoring is effected by a jet of air directed against the rotation of the roll.

B.P. 756,868. Toy figures having bodies of plastic material. M. Zang.

Attachment of a sword or other "hard" equipment to the moulded figure by means of barbs pushed into a recess.

B.P. 756,944. Polyvinyl resin jointless flooring compositions. R. M. Bushby.

Compositions such as "Polyflex" (polyvinyl acetate emulsion with filler, pigment and stablizer) of different colours are formed into a laminated sheet, which is cut into pieces and applied with a trowel.

B.P. 757,030. Mounting or filling means for flat objects. F. D. Attenborough.

For the transport of samples (fabrics, pictures, wallpapers, etc.) in a (traveller's) case, U-shaped holders and flat strips to be hooked over two support rails in the case.

B.P. 757,034. Dispensing tops for powder or like containers. D. R. Collins.

B.P. 757,076. Manufacturing decorated thermosetting synthetic resin objects and thermosetting synthetic resin objects manufactured by the same method. To: Ornapress A. G., (Switzerland).

A paper is impregnated with a binder rendering printing possible and afterwards joint with the plastic material.

B.P. 757,120. Closures for collapsible tubes or containers. A. C. Anselm.

A polythene or polyvinyl chloride tube neck ending in a tapered spigot with a slit is covered by a cap with a tapered axial aperture pressing against the spigot and thus holding the slit closed.

B.P. 757,141. Collapsible containers. H. J. Picking. To: Gestetner Ltd.

The shoulder of a (plastics) ink container is provided with a finger piece so that it can be gripped without grasping the body.

B.P. 757,220. Closure caps for collapsible tubes. H. Phillips.

With a ring moulded integrally with the cap body to permit the tube to be suspended from a hook.

B.P. 757,245. Holder and brackets for supporting ties. H. A. J. Laughton. To: Jarrett, Rainsford & Laughton Ltd.

A bracket and tray (for studs, etc.) part to be attached to a wall and a support with radial arms (for the ties) rotatably mounted on the underside of the tray.

B.P. 757,259. Manufacture of bearing liners. J. B. Thompson (U.S.A.).

From a resilient linear polymer (nylon, polyethylene, etc.) susceptible to a high degree of stressing. A cylindrical liner is formed in a mould with a cavity interrupted by a rib so that the liner has a slot. The composition can contract on cooling without internal stresses.

B.P. 757,300. Method and means for applying metal foil to plastic sheet material. H. V. G. Stubbs.

A sheet of metal foil is passed between a roller with piercing elements and a rubber covered roller. The pierced foil is then placed on the plastic sheet and subjected to heat and pressure whereby plastic material is extruded into the holes of the metal foil. The plastic material may be polyvinyl chloride or rubber (preferred).

B.P. 757,338. Catadioptric lenses. To: Elastic Stop Nut Corp. of America (U.S.A.).

Moulded from light transmitting optical material such as " Lucite " (methyl methacrylate) one " Styron " or " Lustrex " (polystyrene). The outer part of the lens is catadioptric and consists of contiguous annular elements. The central portion is not catadioptric.

B.P. 757,392. Preparation of novolak resins. D. A. Fraser, R. W. Hall, A. L. J. Raum. To: Distillers Co. Ltd.

The rate of formation of novolak resins having high rates of cure may be considerably increased by the use of the salts of organic acids with certain divalent metals as catalyst in the condensation reaction. " Hot hardness " of mouldings is improved and also the surface finish.

B.P. 757,407. Plasticizing and stabilizing of plastic compositions, in particular polyvinyl chloride compositions. B. T. D. Sully. To: A. Boake Roberts & Co., Ltd.

An epoxy derivative of an epoxidized unsaturated fatty oil is employed.

B.P. 757,410. Containers and method for making same. J. A. Banford. To: Unilever Ltd.

A container impermeable to water vapour and/or oleaginous substances is made from a rigid (paper board) support with a thermoplastic (polyethylene or polyvinyl chloride) liner. For an 8 in. container of 3 in. dia., a liner 0.0025 to 0.005 in. thick has been found suitable on a paper board of 0.04 in. thickness.

B.P. 757,466. Plasticizers and gelatinizing agents for highly polymerized substances. To: Dehydag Deutsche Hydrierwerke G.m.b.H. (Germany).

Esters or amides of brassylic acid.

B.P. 757,467. Fountain paint brushes. A. M. Skinner.

For use with children in conjunction with liquid paint (water and colour tablets).

B.P. 757,475. Automatic winding machines for materials such as fabrics, paper, thermoplastics, in the form of strip ribbon or the like. W. Gardel. To: Metalmeccanica S.r.l.

B.P. 757,517. Manufacture of collars for wear. B. E. Screeton, J. G. Evans. To: Bradford Dyers' Assoc. Ltd.

Refers to multi-ply collars with one or both of the outer plies made of an already glazed or polished fabric. The glaze is not adversely affected by subsequent fusing or bonding and does not disappear after laundering.

B.P. 757,528. Method of manufacturing laminar articles. R. J. Wareing. To: I.C.I. Ltd.

Radomes with an edge portion reinforced by a glass fibre-reinforced polyester resin layer.

B.P. 757,530. Flexible laminated materials. To: Lonza Electric and Chemical Works Ltd. (Switzerland).

A semi-finished material of at least one layer of non-elastic textile fabric and at least one layer of thermoplastic material incorporating closed gas cells (polyvinyl chloride). The layers are so united that there is no tensioning of the textile fabric when bent about a radius of 2 cm. The loose connection of textile fabric and plastic foil can most simply be achieved by feeding the foil under tension to the sewing (welding or other) machine. To be used as a lining for articles of clothing, blankets, sleeping bags, etc.

B.P. 757,542. Displays in the form of badges or plaques. A. H. Frank, E. E. Leggett. To: Clearex Products Ltd.

B.P. 757,562. Collapsible containers. M. Maynard. To: Gestetner Ltd.

Collapsible thermoplastic ink tubes (for duplicating machines) have a non-tubular member in their interior of U-, H-, or C-section to prevent the trapping of ink on collapse.

B.P. 757,573. Process for the production of synthetic resins. To: Deutsche Gold- und Silber-Scheideanstalt (Germany).

From unsaturated cycloacetal as starting material. The hardened resin is characterized by high bonding strength to glass.

B.P. 757,618. Educational toy and design device. H. P. C. Keuls (U.S.A.).

A base with multiple perforations and a multiplicity of plugs with equal star shaped heads adapted to interfit when disposed in every other of the perforations.

B.P. 757,628. Method and apparatus for the continuous manufacture of compressed boards or sheets. E. R. Bose (U.S.A.).

Formed of heat expanding cork, wood chips, sawdust particles bonded with thermoplastic or thermosetting resins. The mass is fed to a flat metal conveyor over a heated smooth surfaced bed under a second conveyor and a heat conducting upper bed both beds providing antifriction surface for the belts on expansion of the mass.

B.P. 757,642. Containers for tablets or the like. To: E. K. Cole Ltd., W. G. Savory.

Made from a single polythene moulding with integral press-stud fastenings.

B.P. 757,679. Liquid container dispensing device. H. A. Mare.

A cap with a spout connected by a socket and knuckle joint to be turned from closed into open position. For filling, e.g., cigarette lighters. Polyethylene and cellulose acetate butyrate are suggested as materials of sufficient resiliency for self-sealing.

B.P. 757,691. Process for the continuous production of hollow articles of plastic material. S. A. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny et Cirey. (France).

Ampoules (flasks, bottles) are continuously made from a tube fed stepwise in a plastic state through a correspondingly stepwise open and closed mould in which a sequence of operations is repeatedly performed, i.e., enclosing the tube portion in the mould, evacuating the air between mould and tube, removing the shaped tube portion.

B.P. 757,792. Bottles. J. Tipping. To: United Glass Bottle Manufacturers Ltd.

With a one-piece moulded cap of polyvinyl chloride or other resilient plastics material to be snapped over an annular rib of the bottle.

B.P. 757,814. Method of producing a plastic having a roughened surface. To: Kotitzer Ledertuch- und Wachstuch-Werke A. G. (Germany).

Artificial leather with the appearance of suede is produced by incorporating in a leather like plastic layer particles of a substance soluble in at least one solvent in which the plastic is not soluble. The particles can then be washed out from the surface of the hardened plastic.

B.P. 757,819. Moulding compositions and the production of mouldings therefrom. To: Farbenfabriken Bayer A. G. (Germany).

The composition (for dentistry) comprises a finely-divided polymeric compound in admixture with an activator the particles of the activator being coated with a resin which is soluble in organic solvents. The coating offers protection and allows storage for an indefinite period, so that it is no longer necessary to mix three components as only a liquid monomer has to be added later on.

B.P. 757,901. Adhesive bonding process. B. J. Balfe. To: I.C.I. Ltd.

An adhesive composed of (15–40%) phenol aldehyde resin and (20–30%) polyvinyl butyral admixed with a solvent (40–55%) to produce a desired consistency. For bonding leather to leather or to resin/rubber sheet material.

B.P. 757,917. Devices for use in suspending garments. T. H. Carson.

One part consists of a plastic stud on a piece of adhesive plaster to be stuck on the wearer and the other part is a plastic clip to hold, e.g., stockings or socks.

B.P. 757,918. Closures for bottles and the like. H. West. To: Stadium Ltd.

A one-piece polyethylene moulding of a disc with a skirt having internal annular ribs of successively smaller diameter to fit over different necks of milk bottles.

B.P. 757,929. Moulded plastic display devices. C. L. Smith. To: E. S. & A. Robinson Ltd.

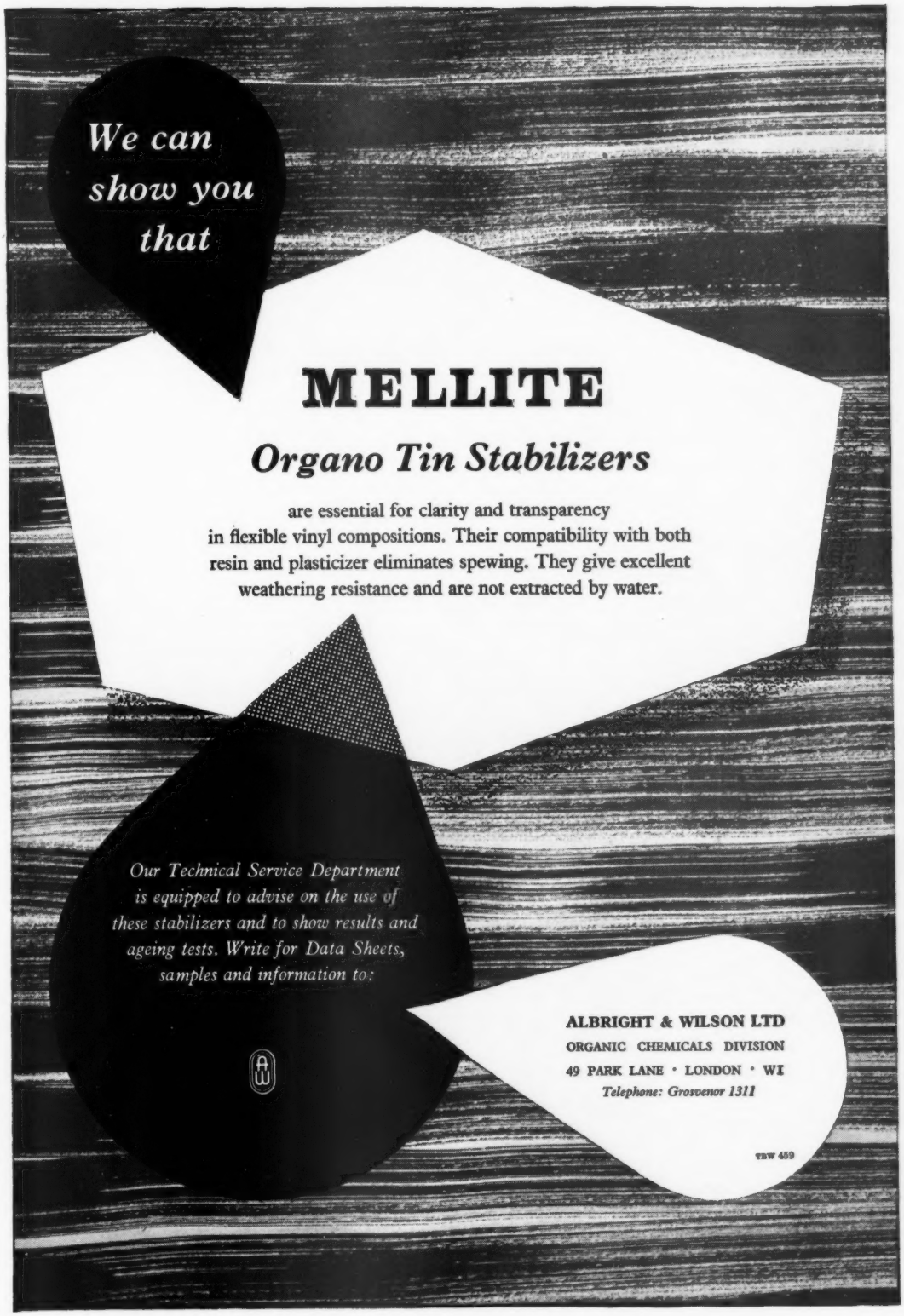
Plastic dummies on show cards are made by placing the card with a hole of the desired outline (e.g. a fruit) over a corresponding die of a suction moulding apparatus and then arrange a sheet of cellulose acetate on top.

B.P. 758,012. Cases for documents or the like. W. Lennartz. (Germany).

Use of plastic edging strips of U-section. The sheets are secured to the thin limbs of the U by sticking or welding.

B.P. 758,036. Embossing thermoplastic sheet. L. J. Moncrieff. To: British Celanese Ltd.

The sheet is positioned by its edges over, but spaced apart from, the patterned surface of an air-permeable fibrous web and heated. When plastic, air is rapidly withdrawn from the space between sheet and web so that the plastic sheet is suddenly brought into close contact with the patterned surface.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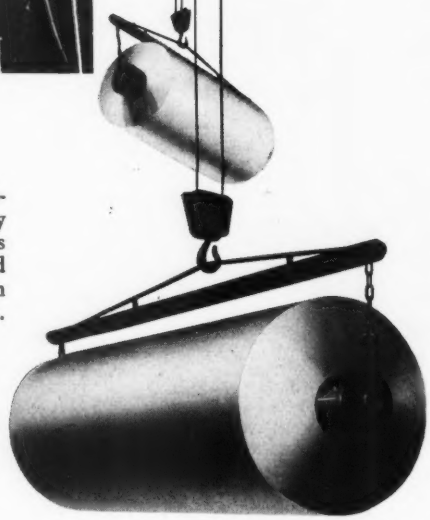

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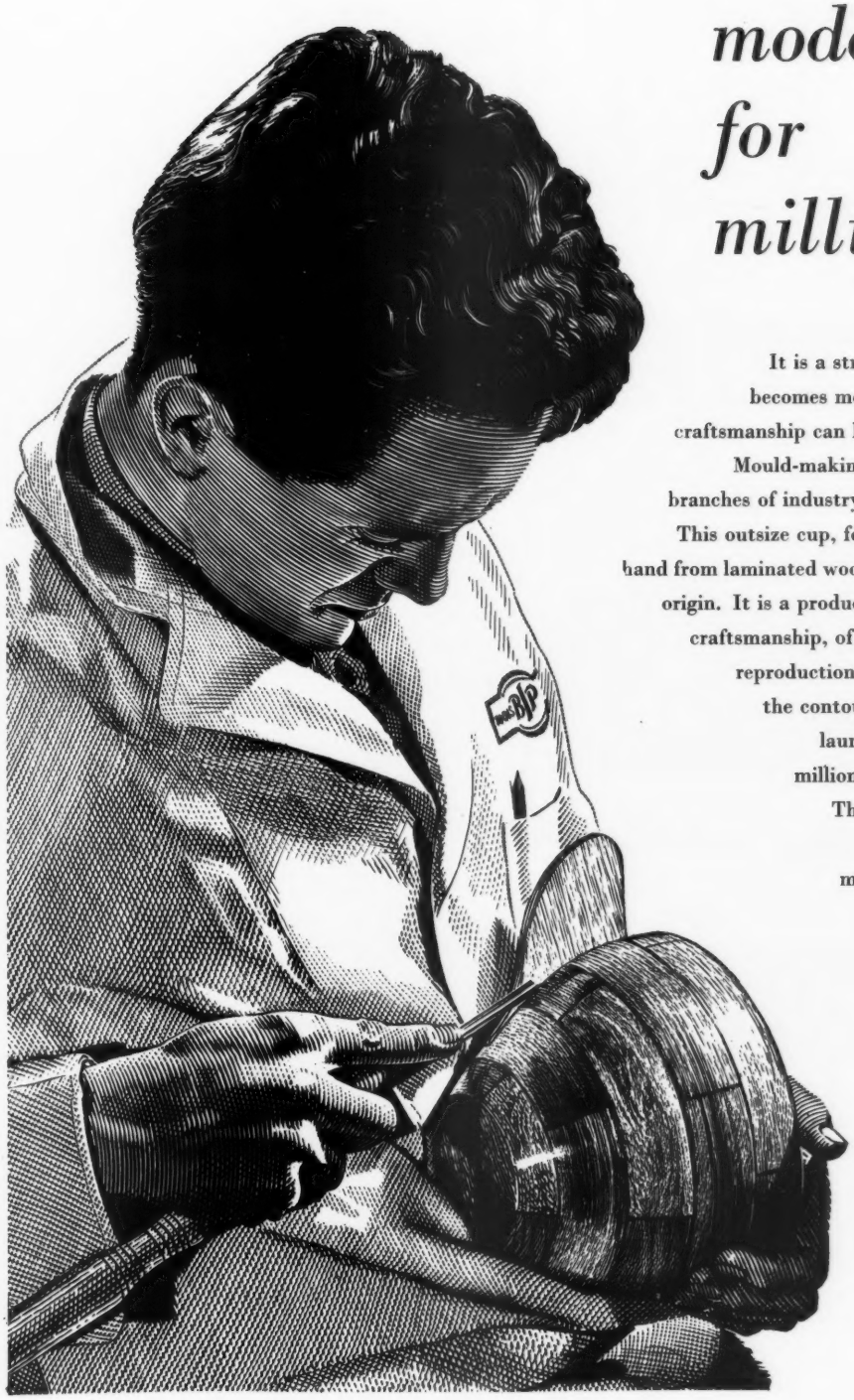

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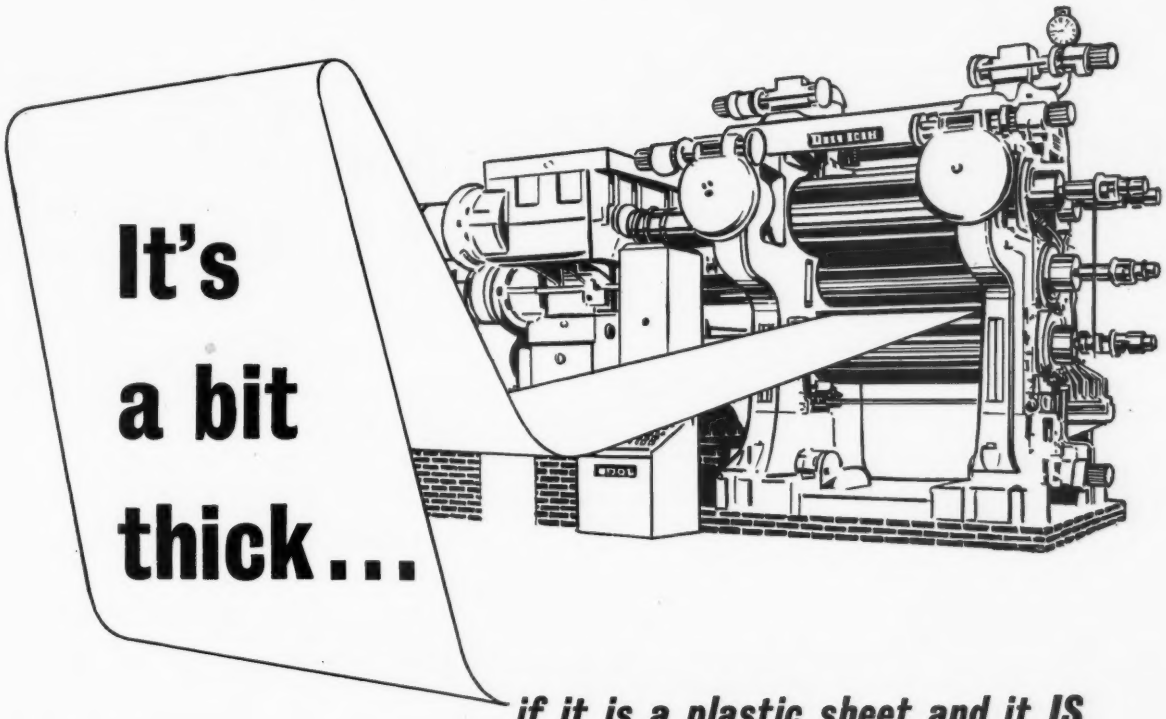

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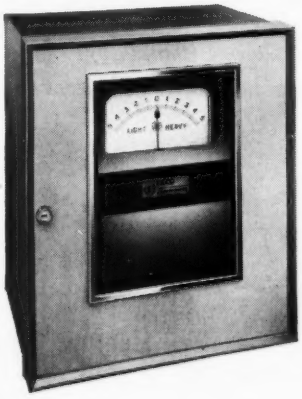

Without touching the flowing sheet the EKCO NUCLEONIC THICKNESS GAUGE eliminates test sampling by giving continuous indication of thickness: it provides immediate warning of variation: it reduces time taken in arriving at the correct thickness when starting up: accuracy is in order of 1% and it is suitable for measuring all plastic materials. The Ekco Nucleonic Thickness Gauge is a time and money saver to everyone who needs control over the thickness of continuous plastic sheet, and coatings of any type on plastic sheet. We shall be pleased to send you further details of the Ekco Nucleonic Thickness Gauges or our Technical representatives will be glad to call and discuss your requirements without obligation.

EKCO

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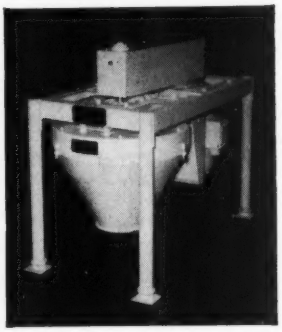

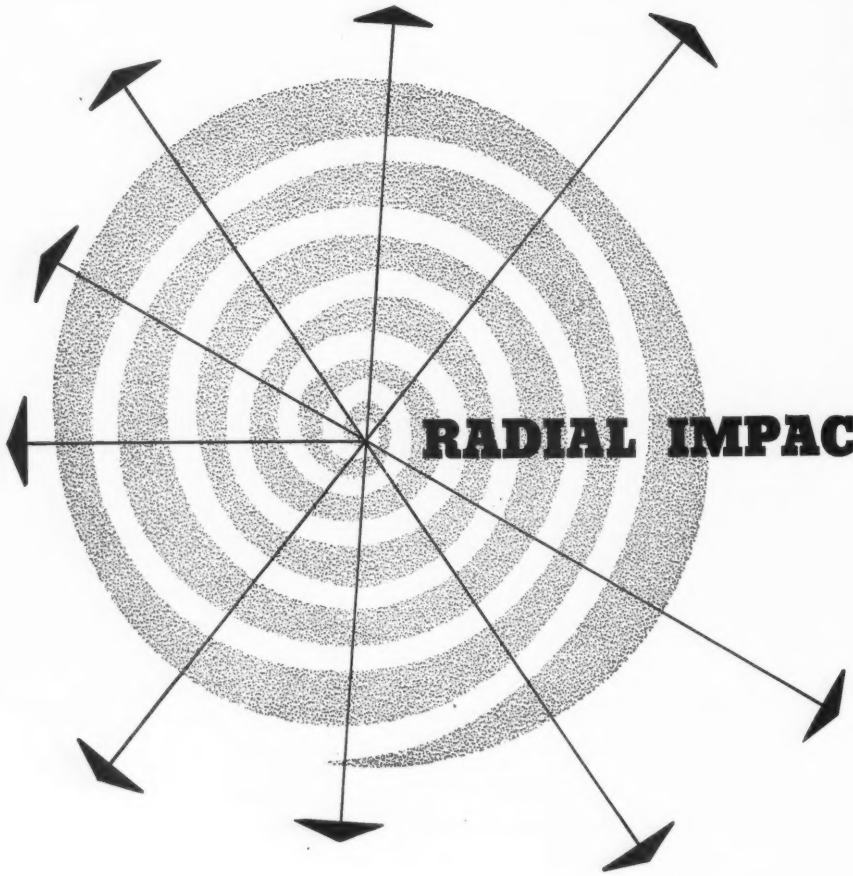

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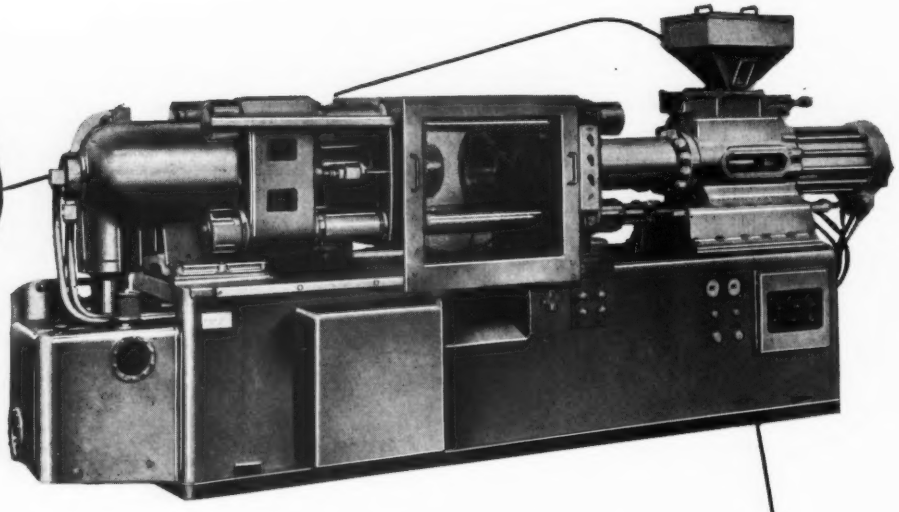

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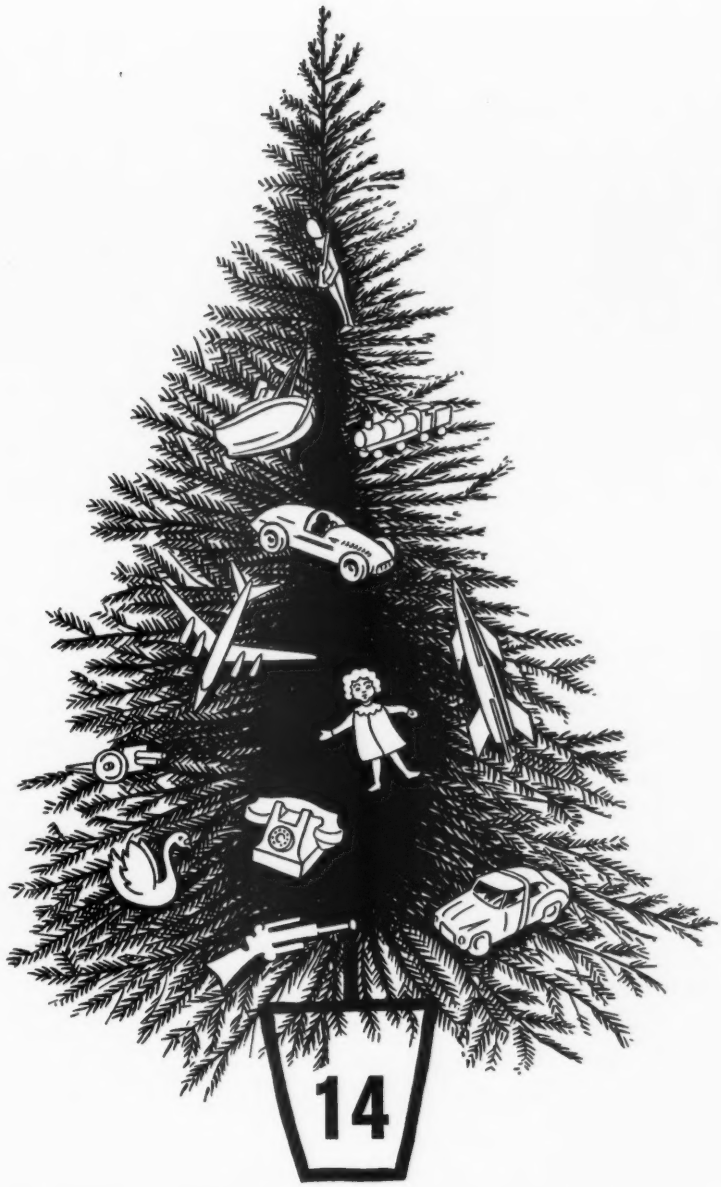

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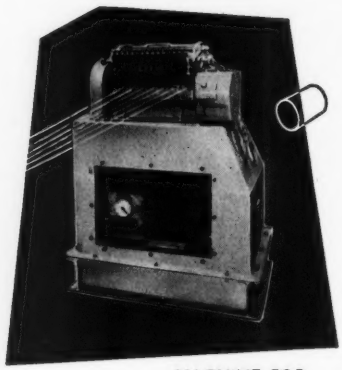

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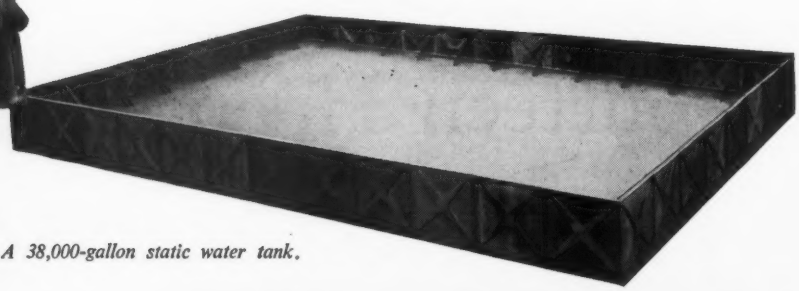

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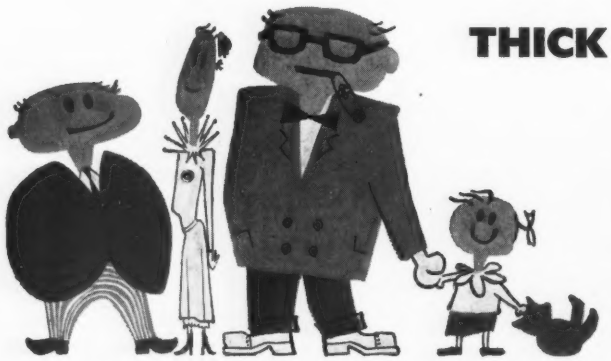

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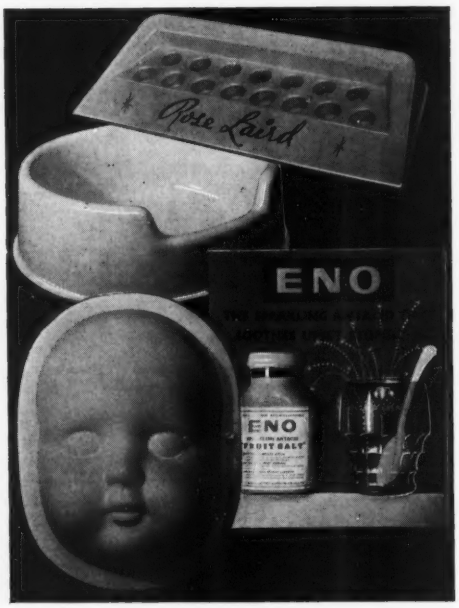

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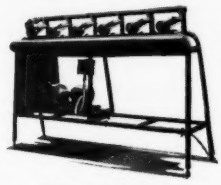

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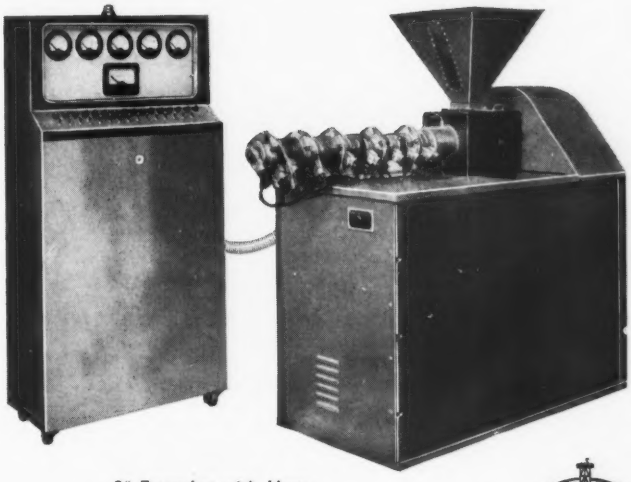

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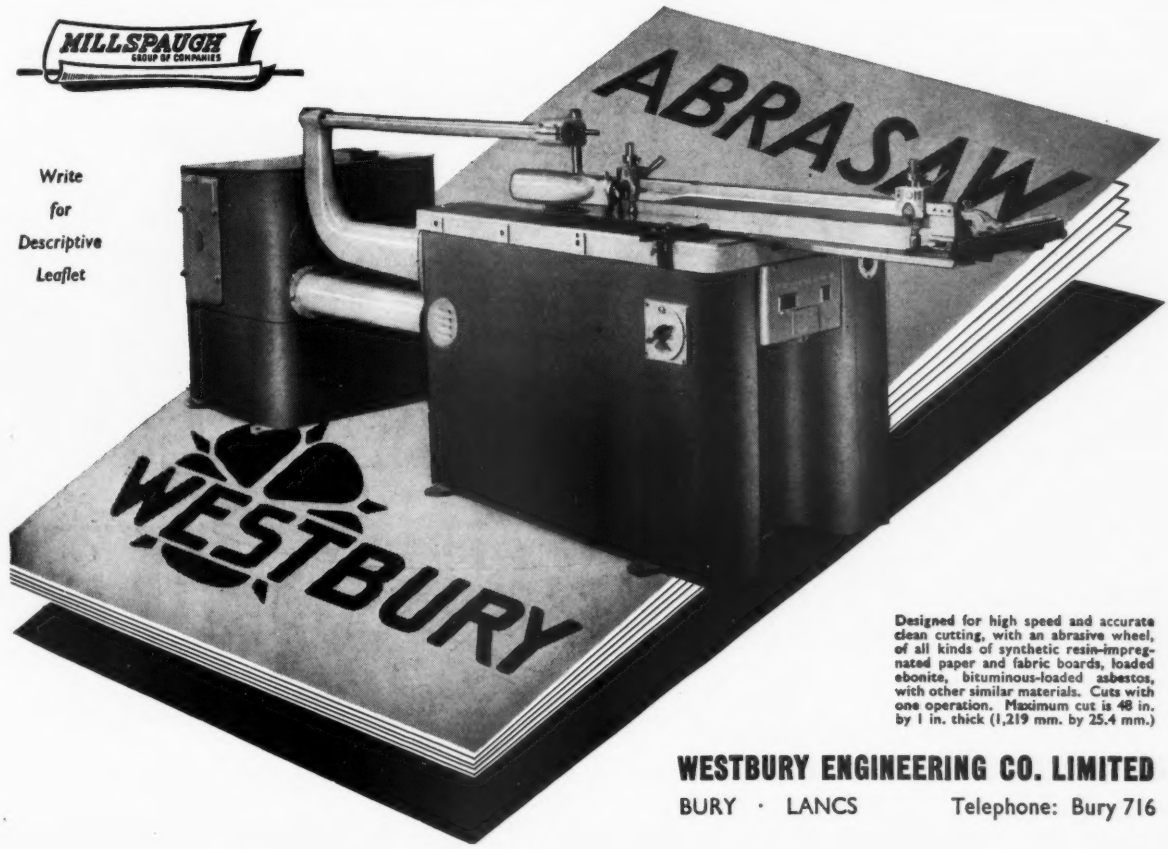

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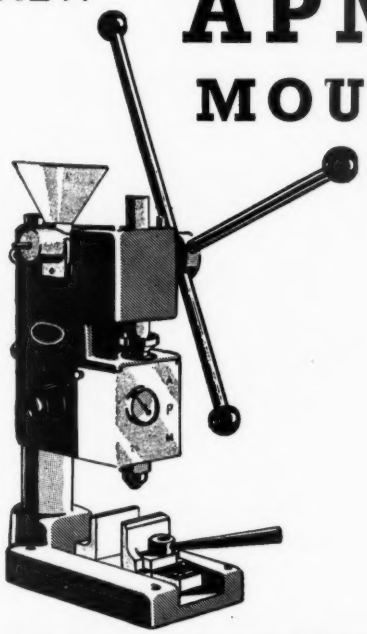

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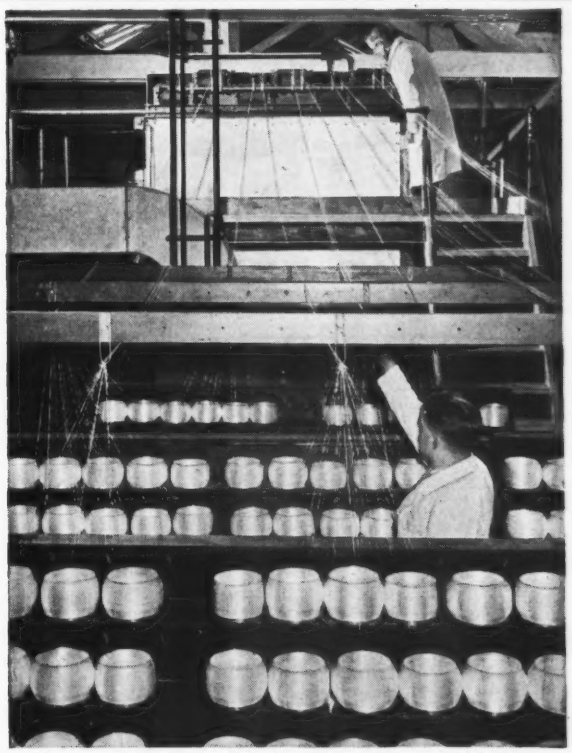

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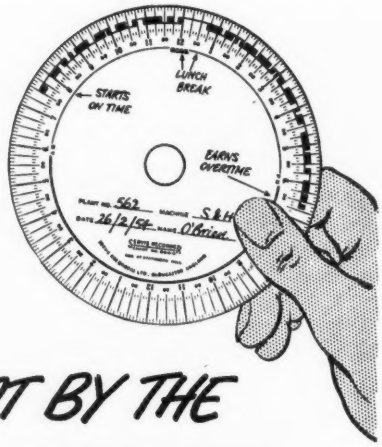

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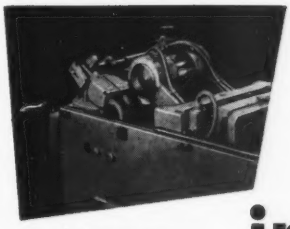

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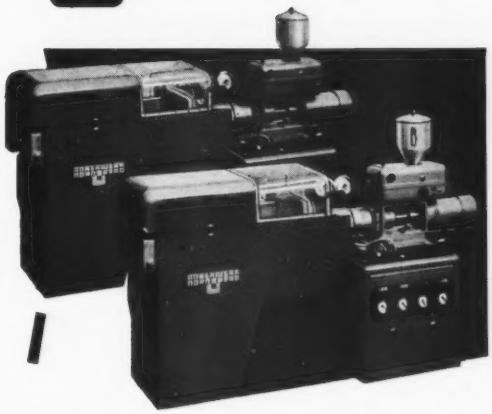

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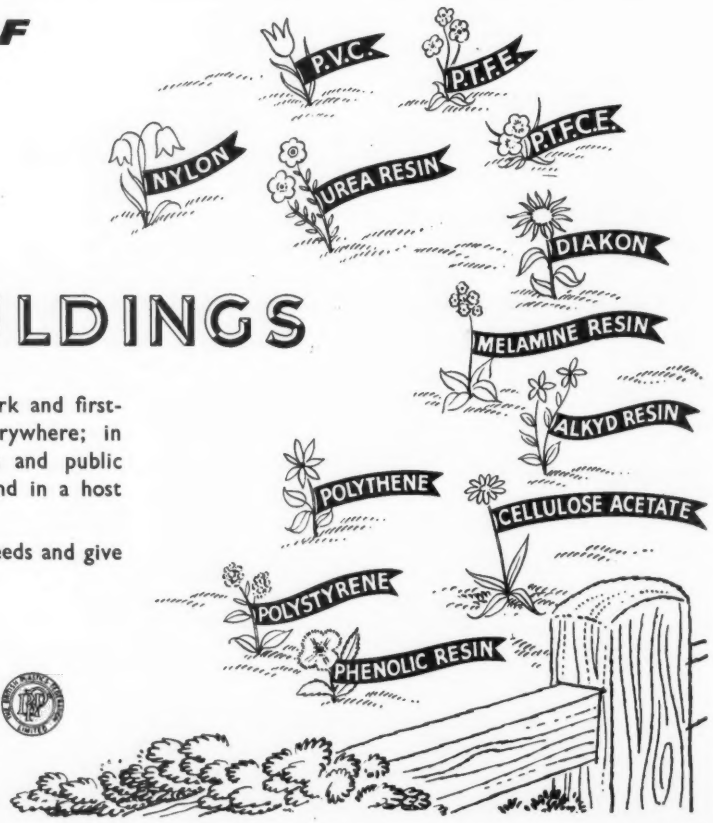

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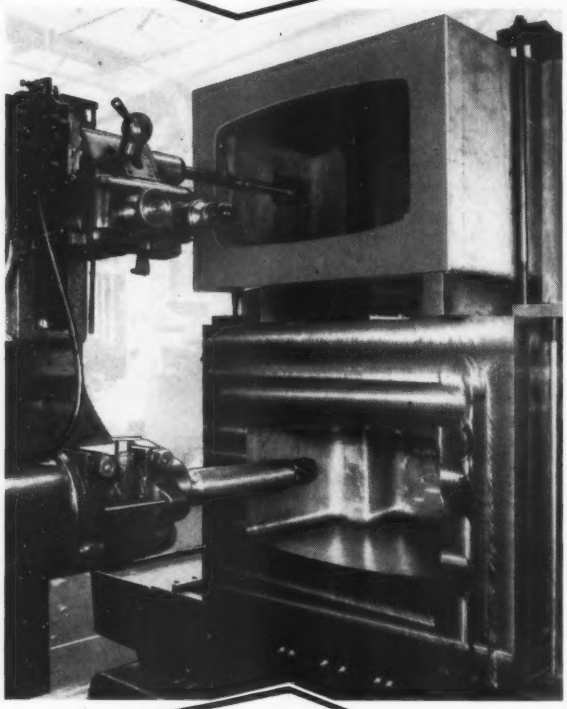

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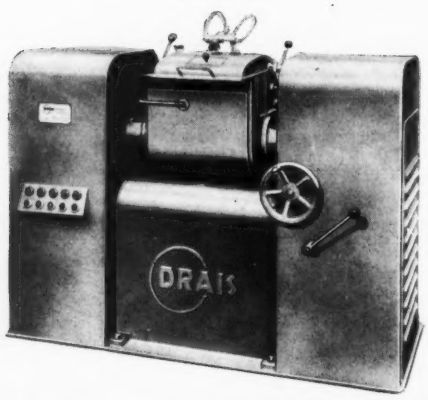

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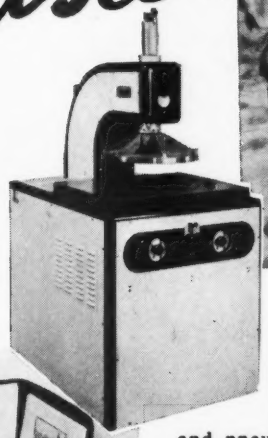

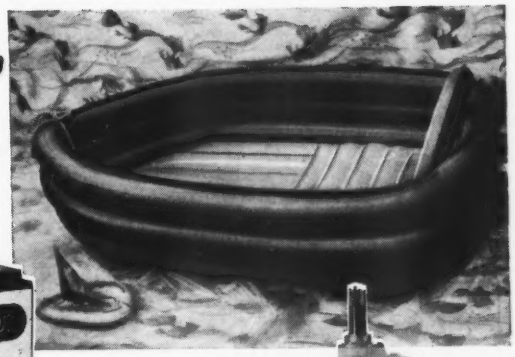

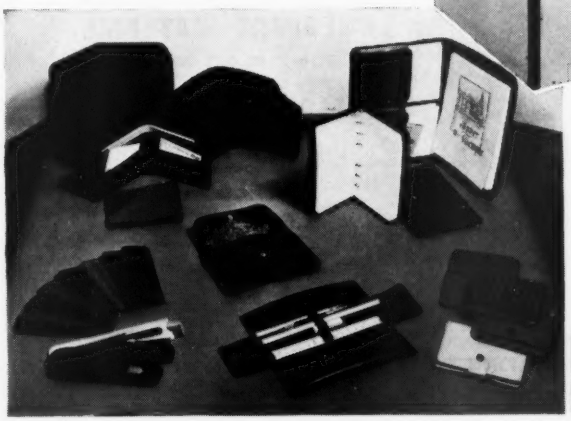

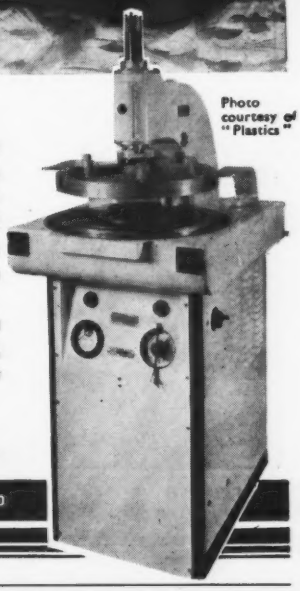

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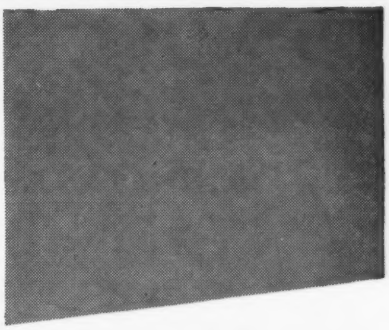

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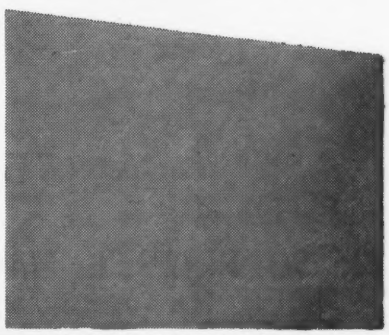

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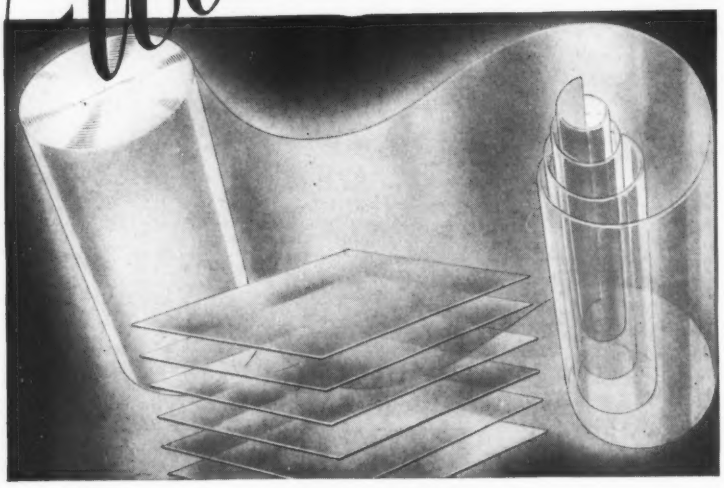

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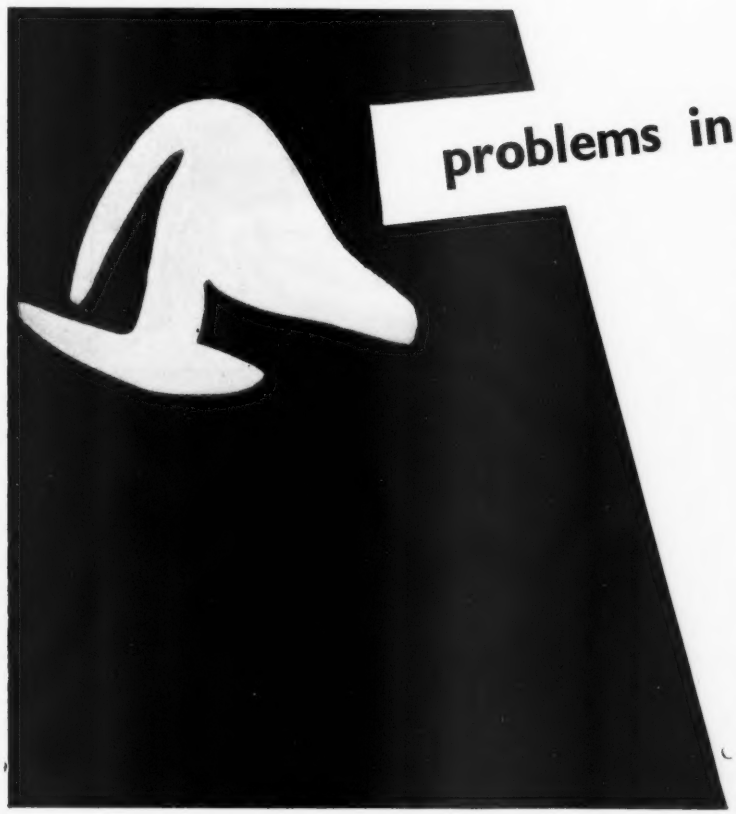

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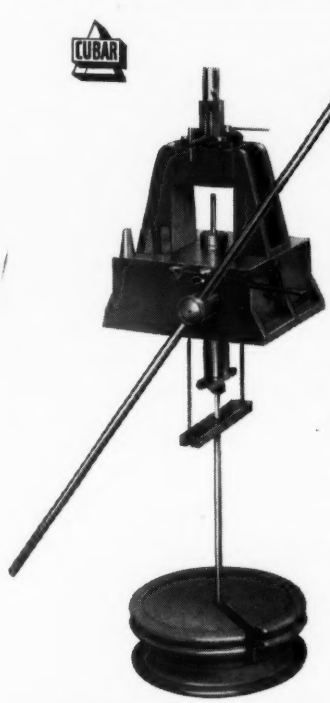

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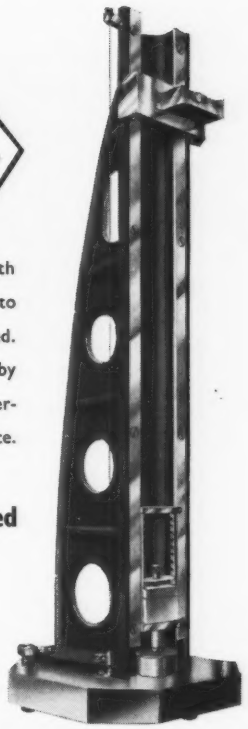

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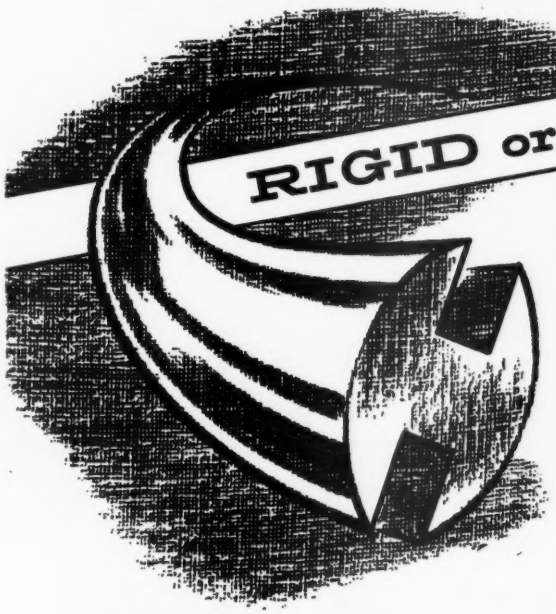

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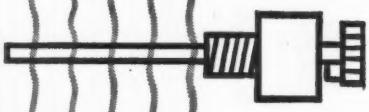

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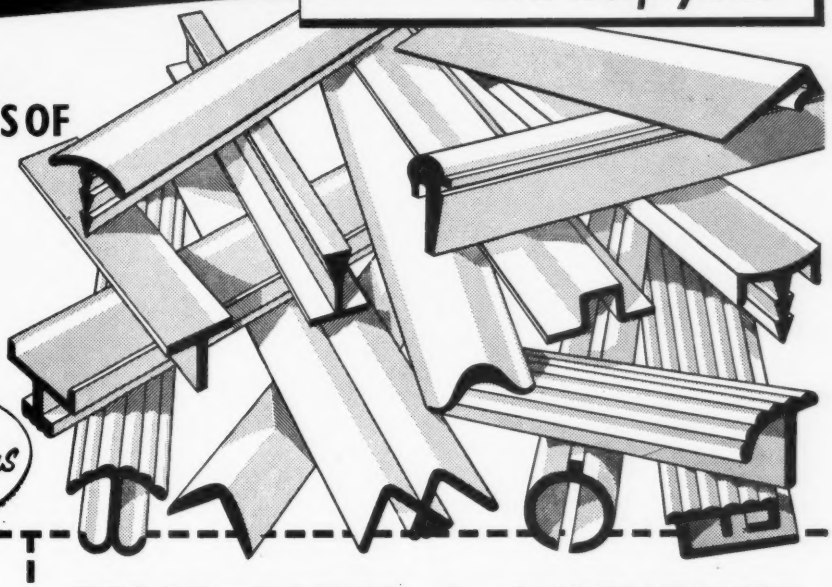

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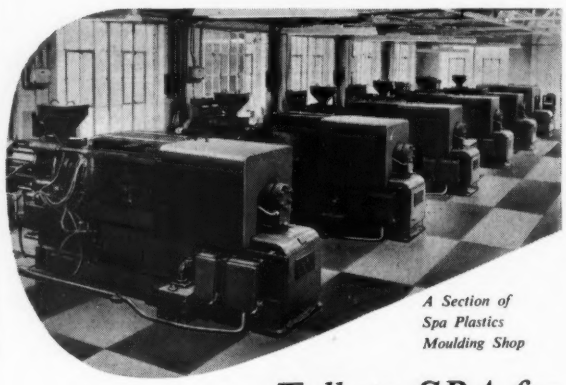

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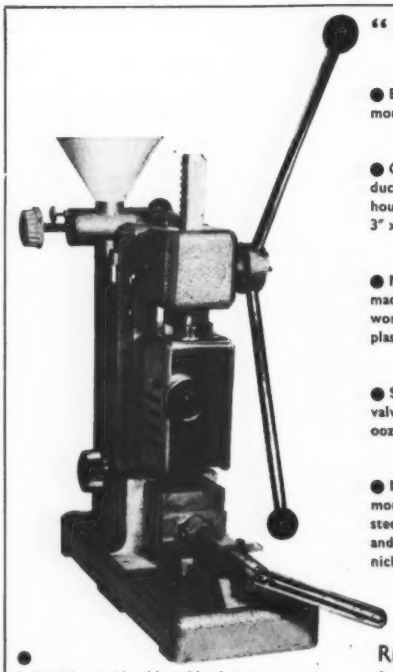

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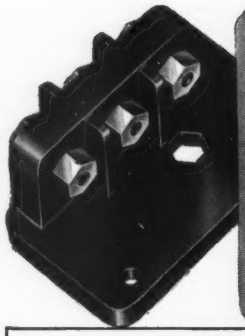

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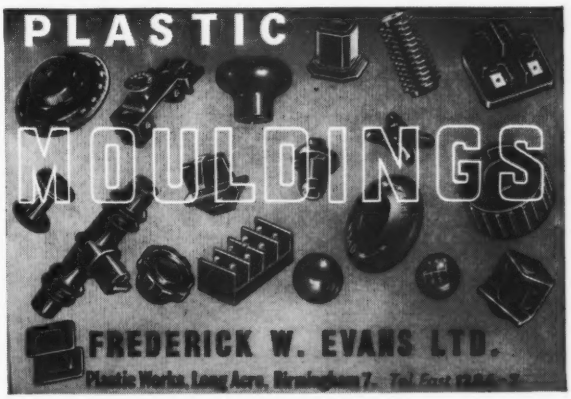

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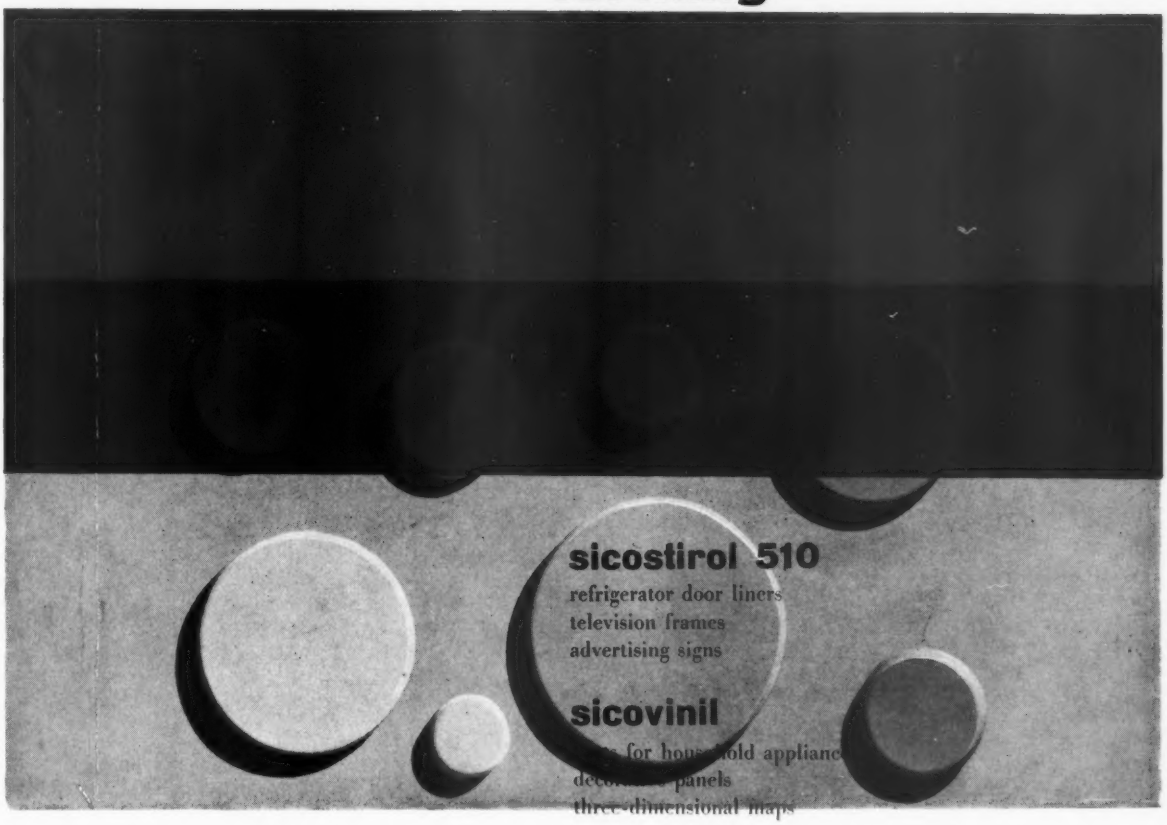

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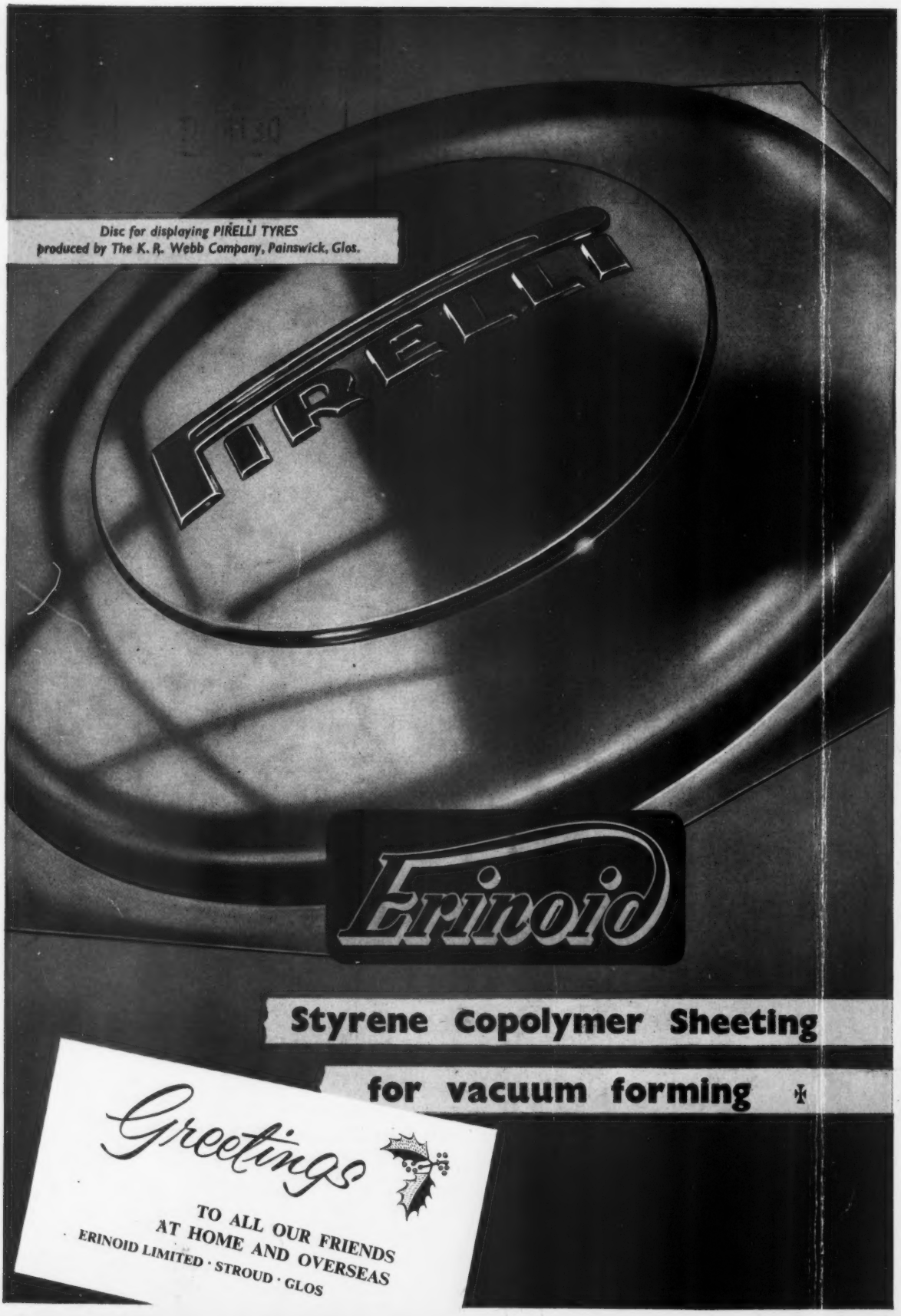

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